WORLD SWORDFISH FISHERIES

Volume IV.

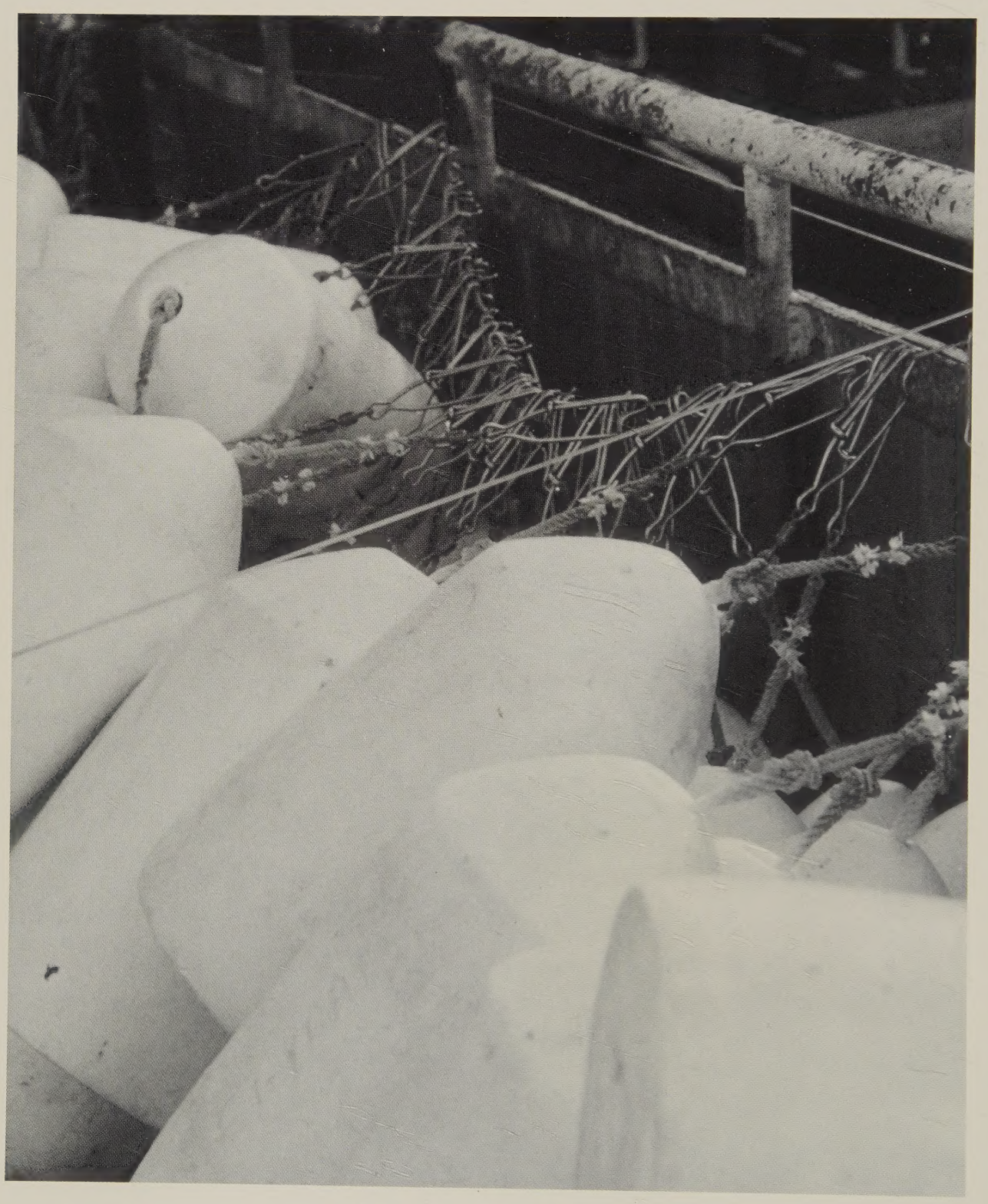
Latin America

Part A. South America

Section 2. Atlantic

Segment B. Brazil

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service



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An Analysis of Swordfish Fisheries, Market Trends, and Trade Patterns
Past-Present-Future

Volume IV.
Latin America

Part A. South America

Section 2. Atlantic

Segment B. Brazil

Prepared by
The Office of Science and Technology

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He escorted the author to view the boat and gear at San José near Recife. **Capitçao de Fragata José Eduardo Gongalves**, Capitania dos Portos do Rio Grande do Sul, briefed the authors on Brazil's enforcement problem. **Tom Grieg** at the University of South Carolina briefed the authors on his interesting work on swordfish genetics. **Dr. Fabio Hissa Vieira Hazin** with the Laboratorio de Oceanografia Pesqueira at UFRPe graciously arranged for a tour of port and processing facilities along the northeastern coast, greatly adding to the authors understanding of the Brazilian fishery. Dr. Hazin has also provided details on his research as well as background on the longline fishery. **Fuad Hissa Hazin**, Director of Norte Pesca, brief ed the author on his company's operations and marketing plans. 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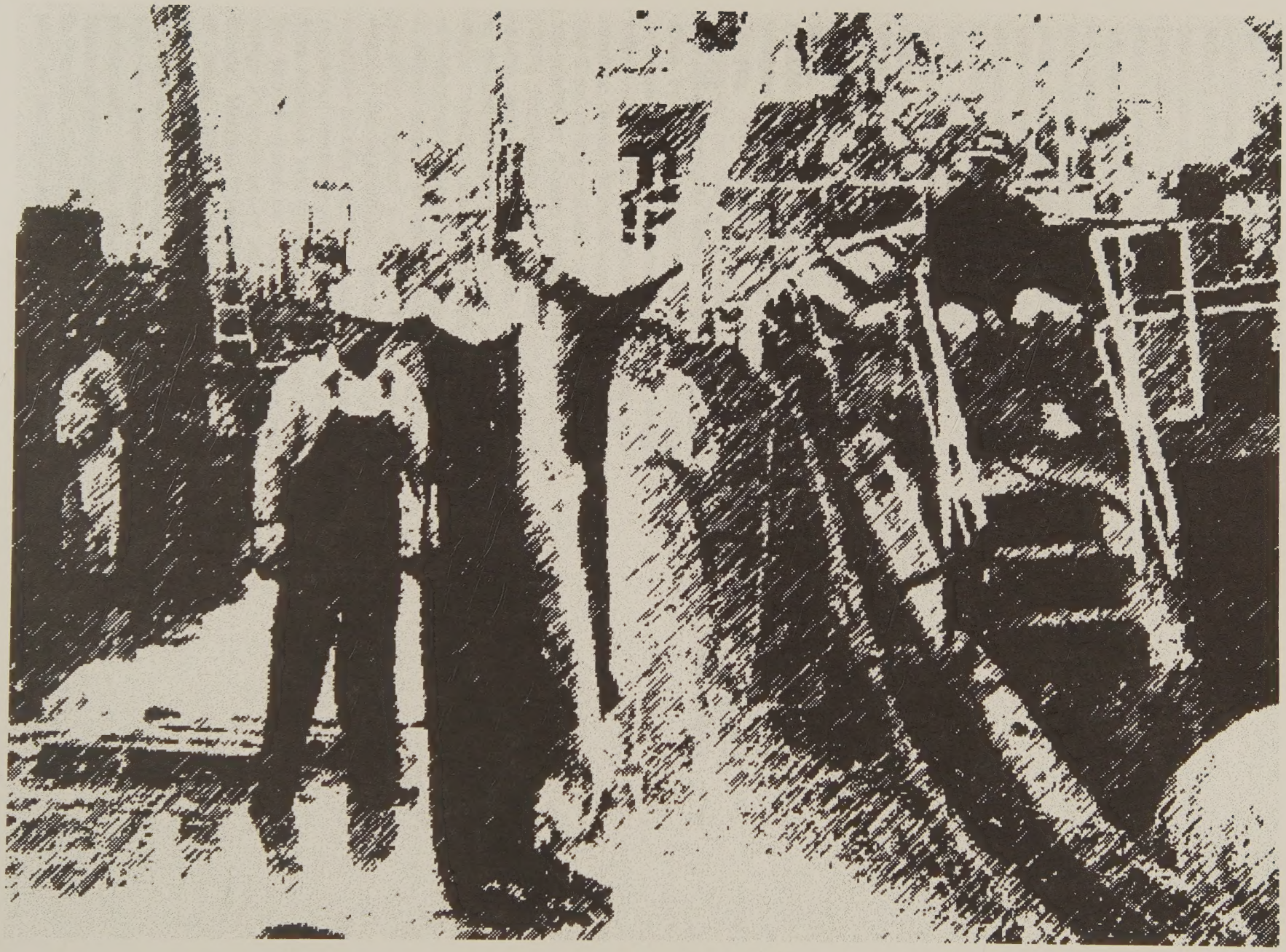

2.5

BRAZIL

The overall Brazilian fishing industry while of some local importance is not of great significance to the overall economy. The country's fishery focuses on lobster, shrimp, sardines, tunas, and various other finfish. It is one of the largest fisheries in Latin America, but despite the country's large coast, catches are far below hose of Chile and Peru. Given the relatively limited production of tropical waters, the Brazilian fishery will probably never exceed its current position as the third largest in Latin America. Brazilian catches approach 1 million tons, although the lack of a strong national fisheries statistical system means that available catch data is often only rough estimates. Brazil has a very large artisanal fishery which lands much of the edible fish consumed in the country. The importance of the artisanal fishery in Brazil make collecting reliable statistics difficult. Unlike many Latin American countries, most of the fisheries catch is consumed domestically and not exported.

The tuna/swordfish longline fishery is a relatively minor Brazilian fishery. The country's longline fishery for years was a minor, multi-species operation out of Santos and strongly influenced by immigrant Japanese. Swordfish catches varied significantly from year to year, but until the late 1980s, rarely exceeded 500 tons. Shore-based jobs were limited because of the lack of value-added processing. The swordfish were simply exported as unprocessed trunks to foreign markets. The objective of the Brazilian longline fishery from the beginning in the 1970s was to supply *sashimi*-grade fresh tuna to the domestic market. Swordfish which could be exported was an extra bonus and the large shark bycatch could be landed. Thus large quantities of the shark bycatch have been landed and marketed domestically because artisanal fishermen had developed a market for shark in the 1960s. The finning and discarding of shark carcasses has not been as big a problem in Brazil as it has in many other countries, although this practice is common with the foreign leased vessels. Blue sharks were initially discarded, but fishermen often avoided areas of high abundance. The Brazilian fishermen now retain even the blue sharks. The longline fishery, however, is small and the overall effort and financial return is limited in comparison to Brazil's much more significant fisheries for lobster, shrimp, sardines, tuna (for canning), and other species.

The nature of the Brazilian longline fishery is changing significantly. The expanding fleet lands the largest swordfish, billfish, and tuna catch of any Atlantic-coast Latin American country. Changing fishing strategy, including directed swordfish sets with monofilament gear, have enabled fishermen to increase catches. The domestic catch totaled only 300-800 tons in most years from 1975-93. New additions to the fleet, including a number of modern, purpose-built longliners as well as small artisanal vessels, are contributing to the catch increases. Longlining methods are being adapted for Brazil's large artisanal fishery which, if successful, could have a significant impact on future catches. Brazil has a very large artisanal fishery, including many vessels which could be adopted for coastal longlining. Initial results have proven promising.

Brazilian domestic fishermen apparently caught nearly 1,000 tons of swordfish in 1994 and 1,200 tons in 1995. This data should be treated with caution, however, as some observers have expressed concern about the accuracy of available Brazilian statistics. The 1996 domestic catch declined to 780 tons. The authors cannot explain the statistical discrepancies. Preliminary 1997 Brazilian data shows that the 1997 domestic catch data suggest that domestic fishermen landing record quantities of swordfish in 1997. One report suggests a domestic catch exceeding 2,000 tons, an all-time record. Fishing in 1998 was excellent, but in August exports to the United States fell below 1997 levels. The fishermen may be reducing fishing effort or redirecting product to the domestic market because of the low international prices. Preliminary reports for 1998 suggest that the catch will be comparable to 1997 or perhaps somewhat higher.

The longline fishery has for years exported the swordfish catch and sold the tuna and billfish in ethnic, largely Japanese, domestic markets. Japanese-Brazilian consumers are generally willing to pay higher prices for seafood than most other Brazilians. The Brazilian consumer, however, continues to increase purchases of the sharks being taken as part of the bycatch. A much wider range of species is consumed in Brazil than in most other countries. The economics of the fishery has been much improved by developing domestic markets for the large quantity of shark formerly discarded. Some fishermen now target shark because the higher catch rates of sharks can make up for the relatively low price. Declines in the international price for swordfish has caused several Brazilian companies to increase the quantity of swordfish marketed domestically. Some companies are expanding the now limited value-added processing for the domestic market and launching local promotions.

Brazilian companies have for years leased foreign longliners from Japan. Companies in the 1990s have reported more diverse leasing arrangements. Taiwan fishermen have been especially active in the 1990s. Spain was not regularly involved in the vessel leases until 1996, but is now a major participant. Small numbers of vessels are leased from many other countries. These vessels have for years accounted for substantial catches of tunas, swordfish, and billfish. The 1996 leased swordfish catch exceeded that of the domestic catch. Leased catches exceeded 1,000 tons in 1997 and probably exceed 2,200 tons in 1998, an all-time record. The principal reason for these increases was the signing of leasing contracts with the Spanish which, with few exceptions before 1996, had not fished in association with Brazilian companies--even though they were active in the south Atlantic--but. The Brazilian Government in 1998 after consulting with the domestic fishermen decided to freeze the foreign leasing program for 1999 at 1998 levels.

Almost all of the country's swordfish catch is exported--in recent years mostly fresh to the United States. The quantities exported have increased significantly. Shipments of 1,200 tons in 1997 are twice 1996 levels and five times 1995 levels. Shipments to the United States may reach nearly 1,400 tons in 1998. Some of the leased vessels (especially the Barbados, Honduran, Panamanian, Portuguese, and United States fishermen) are probably shipping at least some, if not all, of their swordfish catch to the U.S. market. At least some of the fishermen from these countries land fresh product. The Taiwan and Spanish fishermen appear to be landing mostly frozen swordfish, which does not enter the U.S. market.

Some Brazilian companies have had difficulty delivering high-quality product. This problem has been reflected in the marketplace. Brazilian swordfish sells at a substantial discount to fish from most other countries. This discount has been reported for many years, although price spreads have varied. The problem is not well-documented. The authors, however, know of no study identifying quality problems in Brazilian fish and assessing the extent of those problems. Price differentials and anecdotal reports from importers as well as some Brazilian industry sources suggest that there is a problem. The fish taken in tropical waters from northeastern ports in particular appear to have quality problems. Several factors may be involved, including feeding behavior, prey species, growth rates, water depth and temperature, spawning, parasite infestation, and a variety of other factors. Some fishery and handling problems may also be involved, but the primary problem seems to be the natural state of the fish, although the authors know of no reliable study which has focused on this problem.

Brazilian fishermen are perfecting the new directed swordfish techniques and with additional entries of new vessels could possibly increase catches for the next few years. Several factors could limit the long-term future of the Brazilian fishery.

Stock: One limiting factor may be the state of the south Atlantic swordfish stock. The stock has been subjected to increasing fishing pressure since the late 1980s. Management measures introduced by the International Commission for the Conservation of Atlantic Tunas have not yet brought overall south Atlantic catches down to sustainable levels. At some stage, increasing fishing effort will not produce increased catches. Brazil and Uruguay have strong objections to the current ICCAT management program, especially the caps on their fishing. This may not immediately affect Brazil as it still takes only a small part of the south Atlantic swordfish catch. Brazil and Uruguay are, however, working within ICCAT to gain a larger share of the south Atlantic swordfish fishery based upon their status as coastal countries.

Prices: The low prices received by Brazilian exporters significantly constrain operations. Unless Brazilian fishing companies and exporters address this problem, the low profit margins limit the financial returns in the fishery. This will affect investments in gear and equipment and determine plans for future operations.

Bycatch: The Brazilian and Uruguayan swordfish and other pelagic longline fisheries take a substantial bycatch of sharks as well as a variety of non-commercial species, especially turtles and seabirds. Environmental groups

have expressed concern over swordfish stocks and launched a restaurant boycott in 1998 that had some affect on the U.S. market. Environmentalists are also concerned over sharks, turtles, and seabirds. Various international initiatives are underway to protect these species, several of which are threatened or endangered. Although actual observer data is limited, there are indicators that there is a substantial mortality of turtles and seabirds in the Brazilian fishery. If this proves to be the case, environmentalists can be expected to encourage Brazil to adjust its fishery to reduce by catches, especially of threatened or endangered species.

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Figure 1.--Map of Brazil.

I. Industry Overview

Brazil is the largest Latin American country and dominates the Atlantic coast of South America. Brazil has one of the South American continent's larger fishing industries, but fishery catches are still only a small fraction of the massive Peruvian and Chilean Pacific-coast catch. The economic importance of the fishing industry is rather modest in Brazil because the country has developed a massive agricultural and industrial infrastructure in recent years. The industry is, however, of some local importance.

The Brazilian fishing industry consists of a commercial fishery as well as a massive artisanal fishery--the largest in Latin America. The commercial fishery generates significant export earnings, although they are modest in comparison to the earnings generated by other sectors. Large numbers of Brazilians are involved in the artisanal fishery. The fishing industry as whole, however, plays a much less important role in the national economy than in most other Latin American countries.

Photo 1--Fishermen deploy small trawlers, like these vessels in Rio de Janeiro, all along the Brazilian coast. Fred Beaudry

Commercial: The major commercial fisheries are for lobster, shrimp, tuna, catfish, snappers, and sardines. These fisheries are conducted in coastal waters within Brazil's 200-mile zone. The lobster and shrimp fisheries are two of the most important in Latin America. Both generate substantial foreign exchange earnings, although unlike many other Latin American countries, much of the shrimp catch is marketed domestically. Almost all of the commercial fishery is conducted with small trawlers, seiners, and combination trawler-trap vessels, few of which exceed 250 GRT. Much of the country's catch of large pelagics is taken by small purse seiners and baitboats, primarily targeting skipjack for the domestic canneries. There is also a small longline fleet supplemented by larger longliners leased from foreign countries. The longliners target a variety of oceanic pelagics, primarily tuna and swordfish, but also take substantial quantities of sharks.

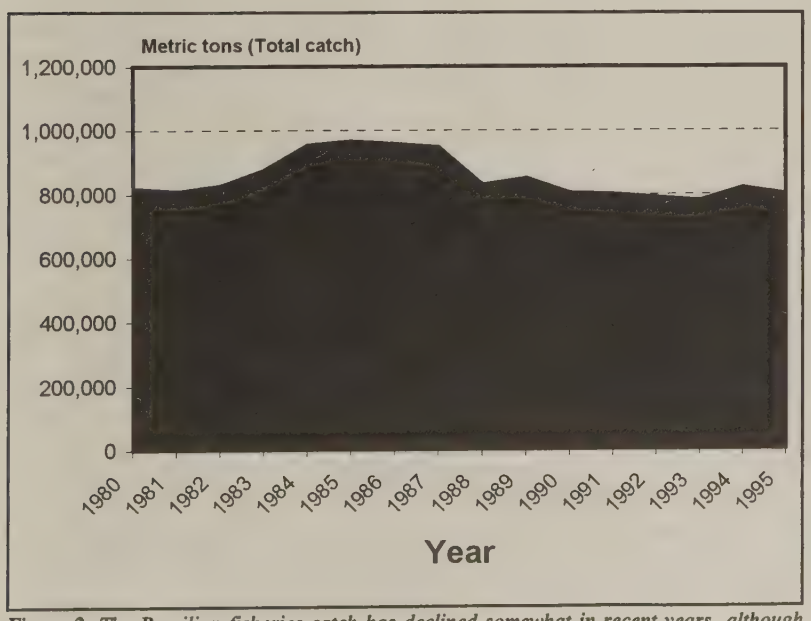


Figure 2--The Brazilian fisheries catch has declined somewhat in recent years, although available data is believed to be only rough estimates.

Artisanal: The artisanal fishery is a major component of Brazil's fishing industry. In some areas, such as the

Photo 2.--Brazil has a large fleet of small commercial vessels like these as well as a massive artisanal fleet which lands much of the catch destined for human consumption. Dennis Weidner.

northeast, artisanal catches are as much as 90 percent of the total catch. The artisanal fishermen utilize a large variety of gear to catch a wide range of finfish and shellfish species. Traditionally the boats were powered by rowing and sailing, but much of the artisanal fleet is now powered by outboard motors.[1] The artisanal fishery is still conducted by a great number of small open boats. In recent years, larger semi-commercial boats have been deployed, although boats of 20 GRT are still generally classified as artisanal. The artisanal fishermen, because of their basically coastal operations, catch very few large pelagics, but the catch of demersal sharks taken in inshore fisheries is increasing. Many artisanal fishermen report rapidly declining earnings because of falling catches. Officials believe that heavy fishing pressure is depleting many coastal stocks. One Government official working with artisanal fishermen along the northeast coast reports that some fishermen are clearing as little as $15 for an entire week of work.[2] Many artisanal fishermen have turned to gillnet operations and expanding effort with monofilament gillnets of varying sizes has been reported all along the country's coasts. One of the species being targeted is shark because a strong market for shark has developed in recent years. The gillnet fishermen also take billfish (especially sailfish), but only rarely swordfish.

The Brazilian Government during the 1960s initiated a major fisheries development program. One of the most important Government programs offered a variety of fiscal incentives to the industry.[3] Most of the incentives were used to modernize the processing industry and considerable progress was achieved in modernizing plants. Fishermen received, however, little help in modernizing their fleet and fishing methods, partially because commercial banks appeared more hesitant to make loans for vessels than for shore-based processing plant. The overall impact of the Government's promotional program is controversial, but the fisheries catch and production of seafood clearly did increase in the late 1960s and early 1970s. The Government has never since intervened in such a major way to promote the fishing industry.

The Brazilian fishing industry is one of the few Latin American fisheries to have approached 1.0 million tons (t); the only other countries are Peru, Chile, and Mexico (Latin America, appendix C1). Some unconfirmed reports suggested that Brazilian fishermen reached 1 million t in the mid-1980s. The Brazilian catch appears to have peaked at just under 1 million t in 1985 and has since declined to about 0.8 million t in 1996 (appendix E1). Some assessments suggest even further declines to only 0.7 million t in 1996.[4] Given the limited Government effort to collect commercial fishery statistics as well as the size and nature of the artisanal fishery, the official data has to be considered only rough estimates at best. Fortunately some of the data available on the longline catch of oceanic species is more reliable because many foreign fishermen and Brazilian research institutes in Rio Grande, Santos, and Recife have maintained an effective data collection system. (See: "Research.")

Brazil's large and growing population offers a huge market for seafood, the largest in Latin America. The population exceeds 160 million (1995). While large numbers of Brazilians live in poverty, there is a large and growing middle class, creating a strong market for seafood. The demand for seafood is especially strong among some ethnic groups, especially Italians and Japanese. While Brazilian fishery catches approach 1 million t, the catch per capita is much smaller than that of many other Latin American countries. As a result,

Photo 3--Artisanal driftnet fishermen have significantly expanded operations in recent years. They take a wide variety of species including sharks and billfish. D. Weidner.

Photo 4.--Fishermen along the northeastern coast report declining catches of lobster and finfish. Many have turned to gillnets and a few are experimenting with longlines. D. Weidner

Photo 5.--Fishermen use vessels of all sizes to deploy gillnets, like this small Santos-based boat. This has greatly increased fishing pressure on many species, including sharks. D. Weidner

Brazil exports a relatively small part of its fisheries catch. In fact, Brazil is one of the few Latin American countries that imports significant quantities of seafood. Brazil has been steadily increasing seafood imports as its economy has expanded strongly in recent years. Imports totaled nearly $0.5 billion in 1996, more than double 1993 levels. Exports on the other hand totaled only $0.1 billion in 1996 and had declined one-third from 1993 levels (Latin America, appendix F1). These trends may be disrupted temporarily by the economic difficulties Brazil and other developing markets are encountering in 1998-99, but the long-term trade trends are likely to persist. Imports are mostly fresh fish obtained in neighboring countries like Uruguay, Argentina, and Chile. Exports are mostly frozen crustaceans, shrimp and lobster.

Longline fisheries are only a small part of the country's overall fishing industry. The Japanese began exploratory longline operations off Brazil in 1955, primarily targeting tropical tunas along the northern coast.[5] The fishery has since been developed by both domestic and foreign fishermen:

Foreign-flag fleet: The Japanese deployed distant-water commercial tuna longliners out of Recife from 1958-65.[6] The vessels operated under the Japanese flag before Brazil declared a 200-mile zone in 1970. (See "Government Policy.")

Domestic fleet: The first domestic longliners were deployed in 1969 out of Santos targeting grounds off southern Brazil (23°-33°S). Other Brazilian longliners began to operate along the southern coast out of Rio Grande (RGS) in 1982.[7] Brazilian fishermen reportedly terminated domestic longline operations out of Rio Grande in 1989. Other Brazilian longline fishermen began operating along the northeast coast in 1983 (appendix A1c). The total number of domestic longliners involved in the fishery has increased steadily from 5 vessels in 1989 to a peak of 21 vessels in 1990 to only 16 in 1994. Brazilian observers report that in 1996-97 several new domestic and foreign longliners were added to the fleet, including several small vessels.[8]

Foreign leased fleet: The Brazilian Government in 1976 issued new regulations authorizing domestic companies to lease foreign longliners and these longliners (mostly Japanese until 1991) have since played an important role in the longline fishery.[9] Brazilian companies leased 2-6 foreign longliners during the 1970s and 1980s. Several other countries (primarily Taiwan) began to provide substantially increased numbers of leased vessels beginning in 1991 (appendix A1c). The number of foreign longliners increased from 6 in 1992 to 14 in 1992 and 30-36 in 1992-93. The number of leased vessels declined sharply in 1995-96, primarily because the Taiwan fishermen decided to refocus operations on albacore in international waters. The Government in 1998 reportedly decided to freeze leasing arrangements in 1999 at 1998 levels and to stop issuing new leases.[10]

The domestic Brazilian longliners have used mostly Japanese fishing methods in a multiple-species fishery targeting primarily tunas and swordfish. Sharks have become an important component of the catch as the demand for sharks has increased in the domestic market. Brazilian fishermen relied heavily on Japanese immigrants to launch the longline fishery in the 1960s and 1970s. The contractual arrangements were with individual Japanese who, once they moved to Brazil, lost professional contacts with the Japanese fisheries community and simply employed the methods learned in training schools and aboard Japanese vessels during the 1960s. As a result, by the 1980s their gear and methods were increasingly dated. The foreign fishermen leased by Brazilian companies have helped to introduce more modern Japanese methods. Beginning in 1991, Brazilian companies began to lease

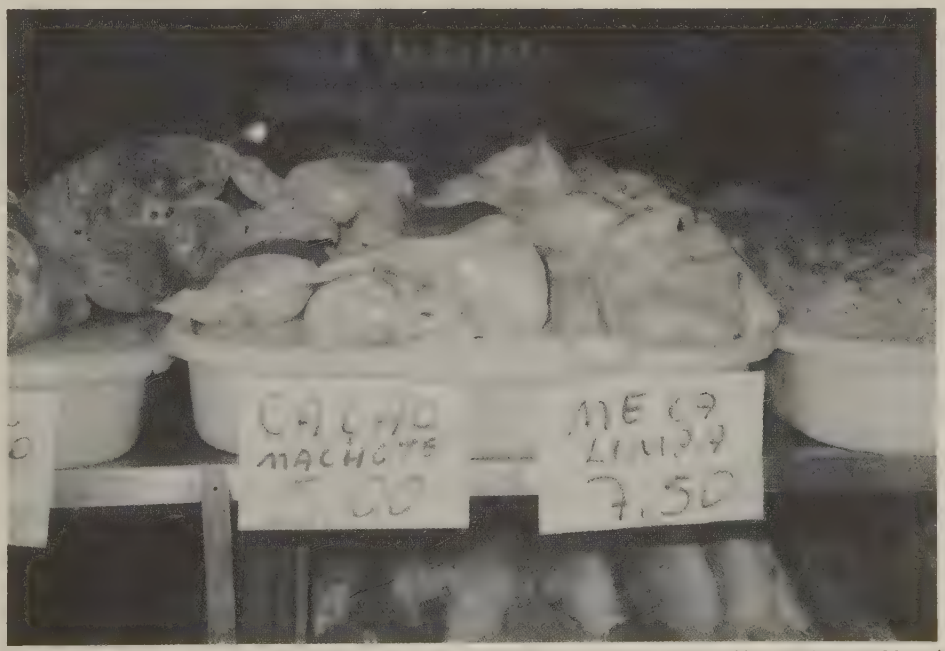


Photo 6.--Shark and swordfish in Brazil are available with skin on (machote) or skinned (limpa). Meca is Japanese for swordfish--showing Japanese influence on Brazilian fisheries. D. Weidner.

foreign longliners from other countries, mostly other Asian countries (largely Taiwan), which also employed gear and methods developed by the Japanese.

Increasing numbers of Brazilian fishermen have begun since 1994 to experiment with U.S. gear such as monofilament line and light sticks and the favorable results have caused many of the principal companies to re-rig their vessels and modify fishing strategy. Many of the boats which began using the U.S. fishing methods and gear targeted swordfish more heavily than they did when using Japanese methods. Some U.S. fishermen off Brazil, for example, report catches that are about 80 percent swordfish (in terms of value).[11] Market trends have also influenced the shift toward greater targeting of swordfish.[12] Although these changes are a new development and still ongoing, they appear to be resulting in substantial shifts in the catch composition and the fishing effort directed at swordfish. The future impact on swordfish stocks is unknown, but expanding Brazilian effort unless distant-water countries reduce their effort could adversely affect the stock. One factor which significantly limits the profitability of the Brazilian longline fishery is quality problems. Many Brazilian fishermen are delivering very poor quality fish--reflected in the low prices the fishermen receive in export markets. There is no consensus in the industry on how to address this problem. Unless it is addressed by the industry, however, the profitability of the fishery will be limited. Even a small increase in the price received, could significantly improve the profitability of the fishery.

Photo 7--The principal Brazilian large pelagic fishery is the live-bait fishery for skipjack tuna. Most of the catch is canned and sold domestically. D. Weidner.

II. Species

A. Distribution

Swordfish occur widely in the western Atlantic Ocean, from Canada south to north-central Argentina. This encompasses most of the Atlantic coast of South America. Swordfish in the north Atlantic, however, have been much more extensively studied than the south Atlantic population. There is no detailed stock assessment work available conclusively describing swordfish distribution in the south Atlantic. Some preliminary assessments can be inferred from available fisheries-dependent data. While available fisheries-dependant data must be handled with skepticism, it is clear that concentrations of swordfish occur in two areas off Brazil:

Tropical: There appears to be a concentration off Africa in the Gulf of Guinea and the mid-Atlantic west of the Gulf.

Temperate: There appears to be another concentration in the southwest Atlantic off southern Brazil and Uruguay.[13]

Several data sets exist on the distribution of catches in the south Atlantic. A variety of problem arise in using the data. Almost all of the assessments on the distribution of south Atlantic swordfish are based on fisheries data. The data shows what the fishermen caught and not necessarily what was actually available. Using such fisheries-based data to assess species distribution in the south Atlantic presents a variety of difficulties.

Extraneous factors: A variety of extraneous factors can prevent fishermen from taking fish even though it was present. Weather conditions could impair fleet operations. Gear may not be appropriate. The size and range of vessels may not permit the fishermen to reach productive grounds. National jurisdiction of coastal waters may impede access of foreign fishermen. Thus fishermen with larger vessels and more modern gear may be forced to operate on grounds where a resource is less abundant than within coastal EEZs.

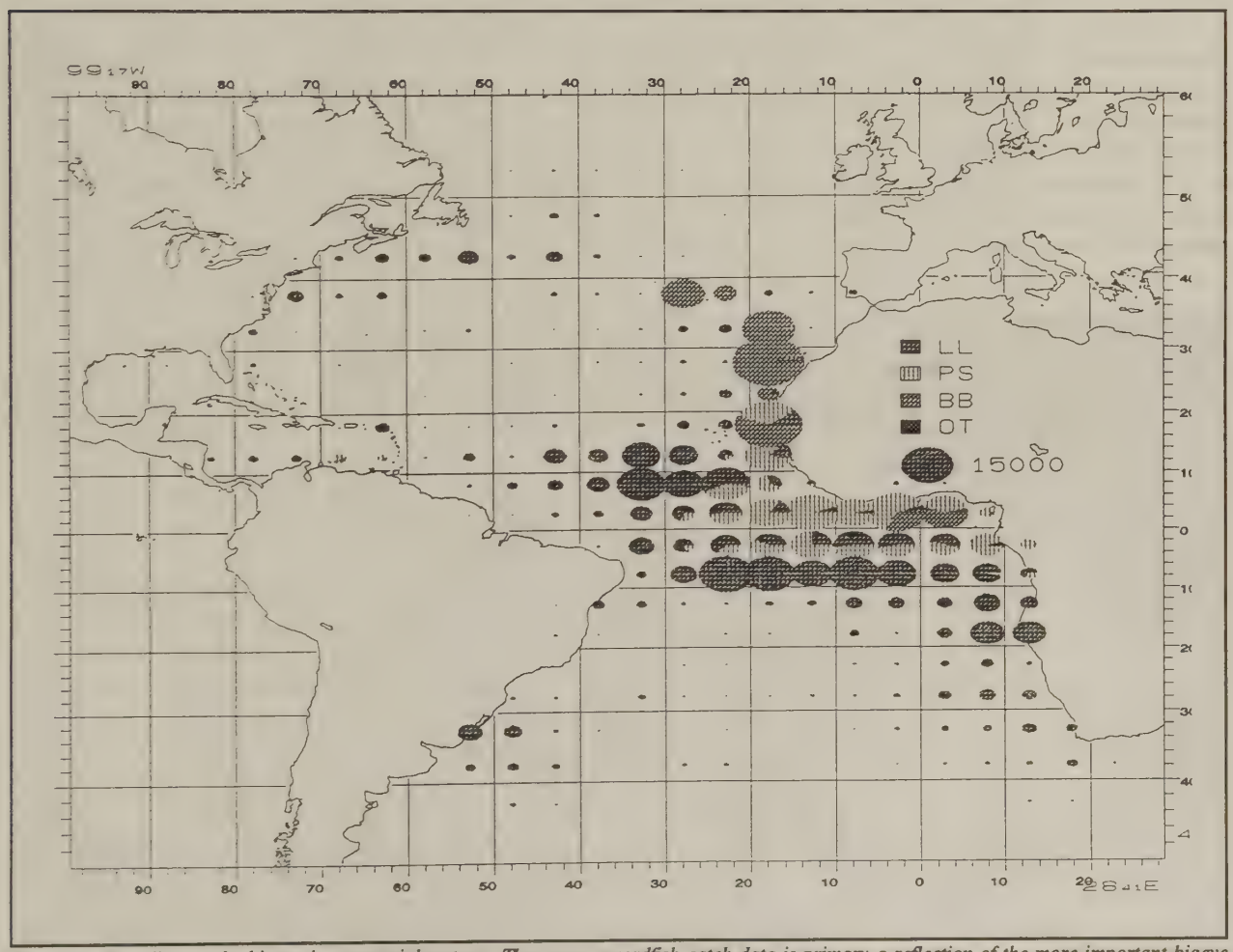


Figure 3.--Longliners take bigeye in equatorial waters. Thus some swordfish catch data is primary a reflection of the more important bigeye fishery. ICCAT Report, 1997 (II).

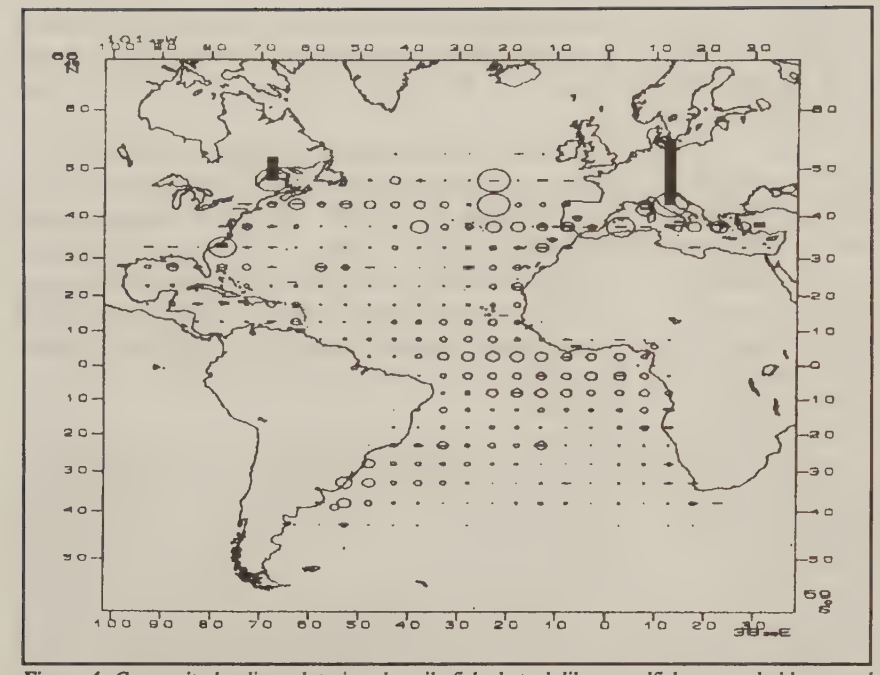


Figure 4--Composite landings data in a heavily fished stock like swordfish are probably a good reflection of distribution. ICCAT Reports, 1997 (II)

Considerations such as these can have a major impact in determining the effort deployed rather than availability of the resource. Fisheries effort and catch data can thus give misleading indications about species distribution.

Target: Swordfish was not the principal target species in most of the south Atlantic longline fisheries (Japan, Korea, and Taiwan). Fisheries-dependent data is particularly limited when trying to assess a species that was not the target of a specific fishery, but were taken as a bycatch. Thus the important Japanese longline data base, reflecting a fishery targeting tuna, must be used with great care. Many distant-water longline fishermen in recent years, especially the Japanese, have focused on bigeye tuna (figure 3). Thus swordfish catches are consequently heavily influenced by bigeye fishing strategy, which has concentrated on equatorial waters, especially off Africa. Even so, the Spanish fishermen who do target swordfish have shown a similar equatorial pattern (figure 4). This suggests that data on Japanese swordfish catches, despite the fact that they targeted bigeye, may still be useful in assessing swordfish distribution--if used with caution. This is important as the Japanese have the largest, most comprehensive data base on south Atlantic longline fisheries.

Flag: Some countries published reports on south Atlantic results do not include the catch of vessels leased by Brazilian companies because the flag is temporarily transferred. Some Japanese data, for example, does not show fishing off Brazil even though small numbers of longliners have operated off Brazil through leasing arrangements with Brazilian companies.

Accessibility: Some of the data compiled by the domestic and distant-water fishermen is not easily accessible to researchers. Language problems make Asian research difficult to locate and use. The published statistical data also poses problems. Most of the published summaries focus on tuna. Swordfish is often either omitted or combined in a general billfish basket category.

Complications: Another problem is that some of foreign vessels operate under leasing

Photo 8--Records are kept at the Santos Fishing Terminal weighing station on each sale. D. Weidner

arrangements with Brazilian companies. Data on their results is sometimes included with the foreign reports, but sometimes excluded.

Great care must thus be taken to understand the exact nature of the data set. With precaution, however, some insights can be gleaned through an assessment of the various national data bases.

ICCAT has compiled data combining available data sets of countries whose fishermen operate in the south atlantic. the results show the area off southern Brazil and Uruguay as an area of relatively high abundance (figure 4). Some specific national data also shows particularly high abundance off Uruguay and southern Brazil. The Japanese data is the most extensive. While showing the focus on equatorial and the eastern south Atlantic, Japanese data, including the leased vessels, does show an area of high swordfish abundance off southern Brazil and Uruguay (figure 6). Taiwan data shows very substantial yields off southern Brazil (figures 11-14). Spanish data covers a shorter time period, but their data may be of greater value because they have been targeting swordfish directly. Korean data is less useful because of the longline fishery has been active primarily in equatorial waters and swordfish has not been a high priority for them.

Photo 9.--The data compiled by foreign distant-water fishermen provide valuable insights on Atlantic swordfish distribution. Note the multi-species catch and seabirds in the water.

National data sets include:

Japan: The most extensive data on swordfish distribution has been compiled by the Japanese using data from their Atlantic longline operations since 1957. Some of their published data omits catches off Brazil. The leased vessel temporarily operated under the Brazilian flag under contractual arrangements (figure 5). Thus some reports treat the catch as Brazilian rather than Japanese catch. One of the available assessments of the Japanese data points to the area off southern Brazil and Uruguay as seasonally one of the three principal areas of high concentration (figure 6).[14] Using the Japanese data presents some difficulties as swordfish was not the principal target species. Despite the limitations of the data set, however, it does provide the best available insight on swordfish distribution in the Atlantic. Japanese longlining has covered a huge area of the south Atlantic over several decades. The Japanese have focused on the equatorial waters of the central Atlantic and areas of the southeastern Atlantic off West Africa. Operations in

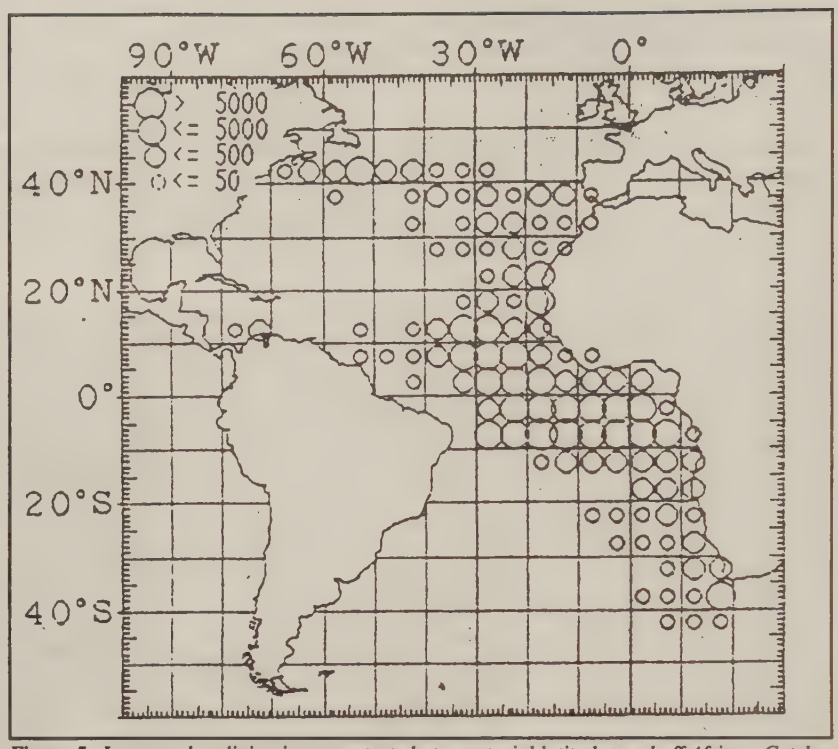


Figure 5--Japanese longlining is concentrated at equatorial latitudes and off Africa. Catches with Brazilian companies are not included. ICCAT Reports 1994 (I).

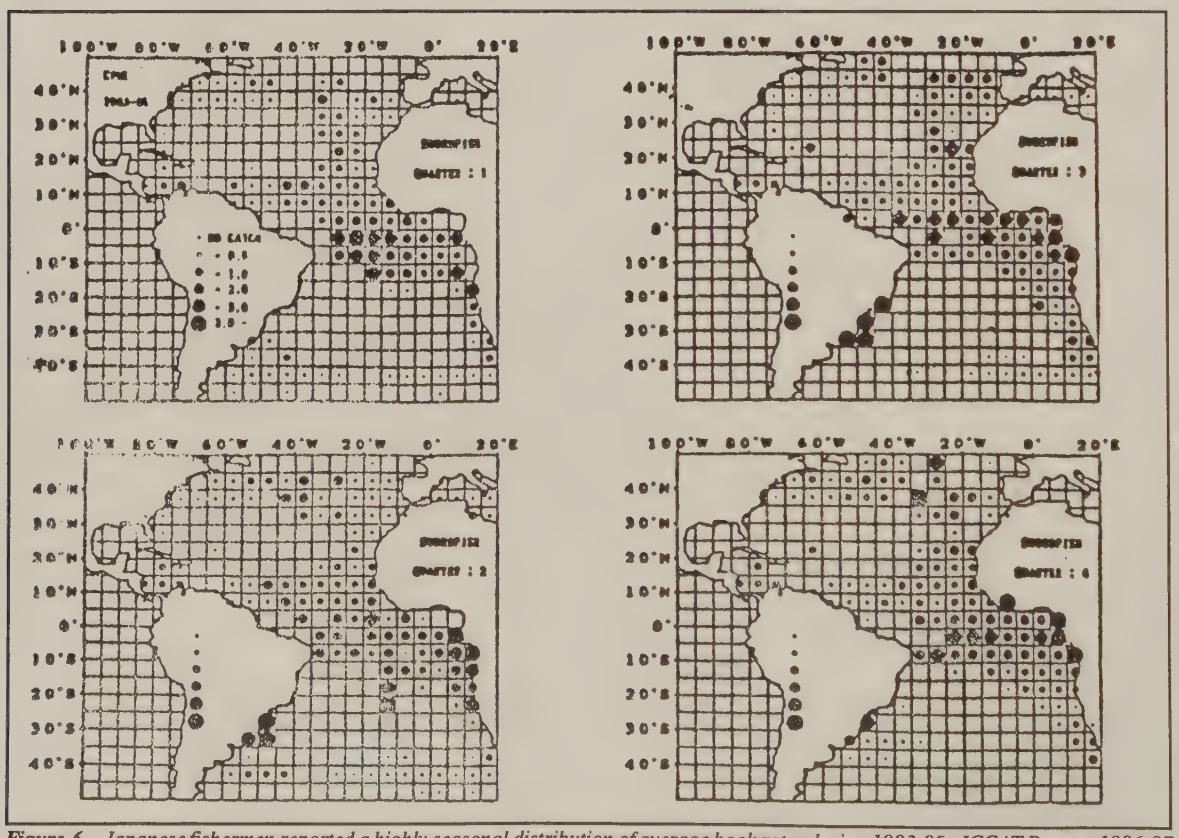


Figure 6.--Japanese fishermen reported a highly seasonal distribution of average hook rates during 1983-85. ICCAT Report, 1986-87 (II).

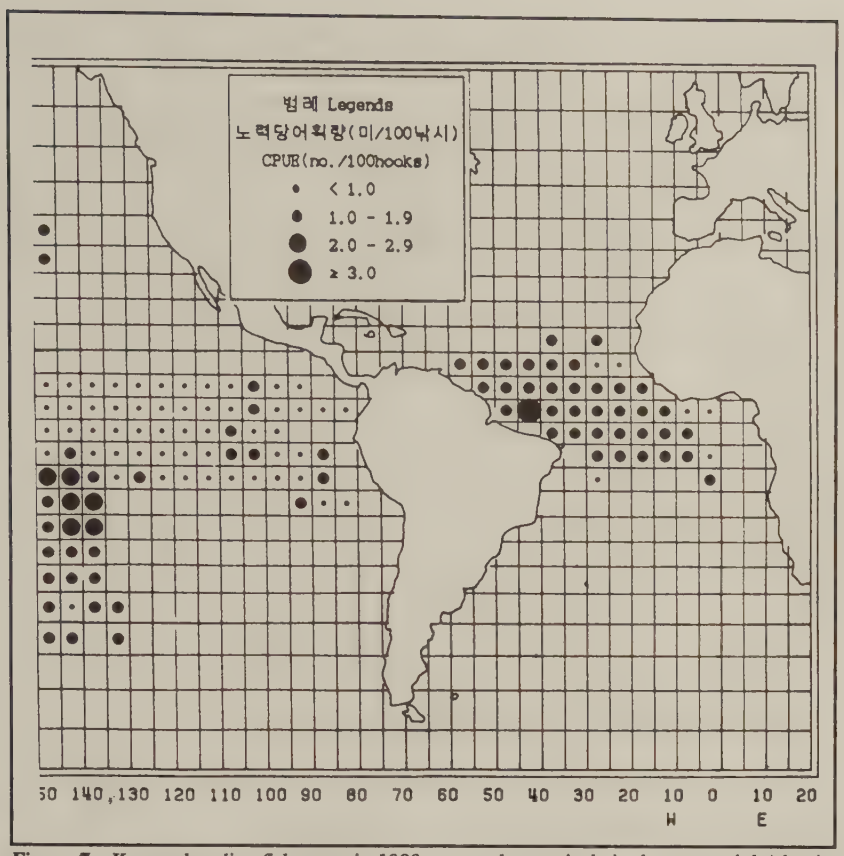


Figure 7.--Korean longline fishermen in 1989 operated extensively in the equatorial Atlantic, including grounds off northern Brazil. The CPUE results are for all species. Korean NFRDA

northeast coast at 10°N-5°S and 25°-35°W. Korean longliners reported catches in 1989 from 20°N-15°S in a relatively evenly scattered area, including grounds off northern Brazil. Korean longliners reported more limited operations in 1990, moving out of the Gulf of Guinea off West Africa. Operations in 1991 moved away from the Brazilian coast to the east, but results were much more limited than in previous years. Korea operations in 1992 were mostly north of the equator, northeast of Brazil--at mid-Atlantic longitudes. The 1992 data is the latest year for which data is available.[16]

the southwestern Atlantic have been much more limited.

Korea: Korea publishes details on their longline tuna fishery. While no data is available specifically on swordfish results, the overall Korean Atlantic longline fishing pattern is of interest because there is a billfish/swordfish bycatch. Atlantic operations are a small part of the overall Korean distant-water longline operations.[15] The Korean operations in the Atlantic have primarily been conducted on the high seas as they have leased only a few vessels to Brazilian companies. Korean longline operations in 1988-92 were all reported at tropical latitudes between the Guianas/northern Brazil and West Africa. Korean longliners in 1988 reported activity from 15°N-10°S, north of Brazil off the Guianas and west of Brazil in the central equatorial Atlantic and off West Africa. The best catch rates were achieved northeast of the Brazilian

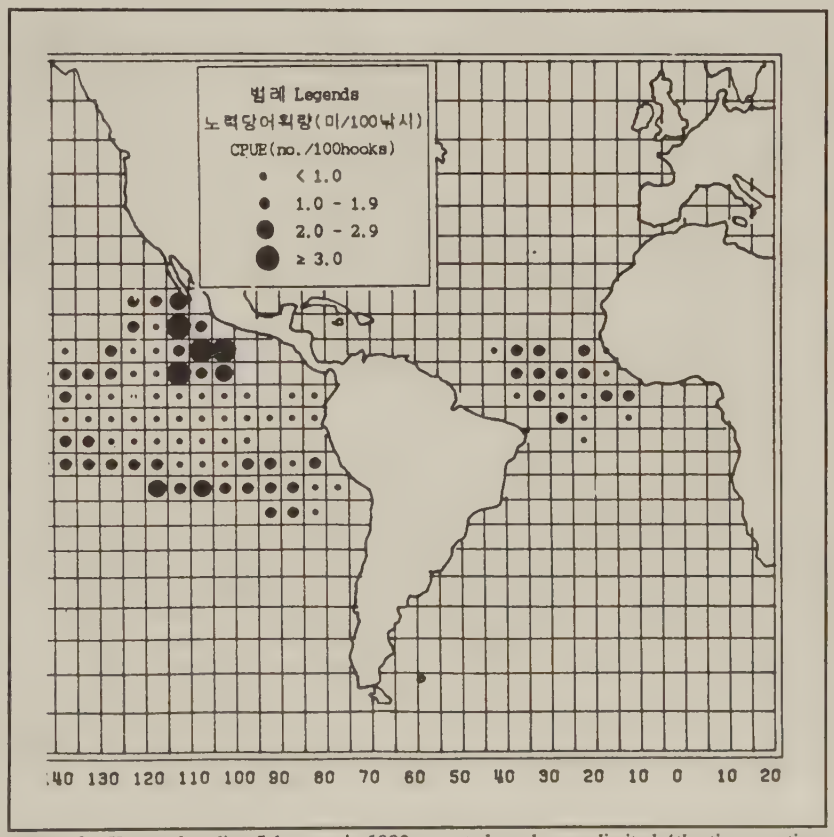


Figure 8.--Korean longline fishermen in 1992 reported much more limited Atlantic operations and low catch rates (all species). Korean NFRDA

Spanish: The Spanish longline fleet until the late 1980s operated in the north Atlantic, primarily in the central and eastern Atlantic off Spain. The heavy effort on north Atlantic swordfish, however, forced the countries active in the fishery to reduce effort through measures adopted by ICCAT. Many Spanish fishermen, faced with restrictive catch limits, decided to shift operations to the still lightly fished south Atlantic. As a result, the Spanish fleet since 1988 has been one of the most active in the south Atlantic. Spanish effort initially focused on the eastern Atlantic off Africa (figure 9). The Spanish subsequently initiated operations much further south (south of 25°S), off southern Brazil and Uruguay (figure 10). This more southerly fishery is conducted at considerable distance from home ports, but was aided by access to the Uruguayan port of Montevideo. The Spanish use the port to exchange crews, buy supplies, make minor repairs, and transship their catch.[17] The Spanish data, while not as extensive as the Asian longline records, has considerable value because the Spanish directly target swordfish. Spanish fishermen in the late 1990s have expanded operations off Brazil through leasing arrangements with Brazilian companies. The Spanish operations have been primarily conducted in association with the Cabedelo de Pesca company. (See "Organizations: Companies".) They have primarily involved fishing out of the small northeastern port of Cabedelo, north of João Pessoa and Recife. (See "Ports".) The Spanish fishing effort on such a heavily fished stock as south Atlantic swordfish probably represents an increasingly accurate indicator of distribution, at least for the areas in which the fleet has been able to operate. This will be especially true with 1996 data as the leased vessels obtained access to Brazilian waters, reducing the distortion of access restrictions.

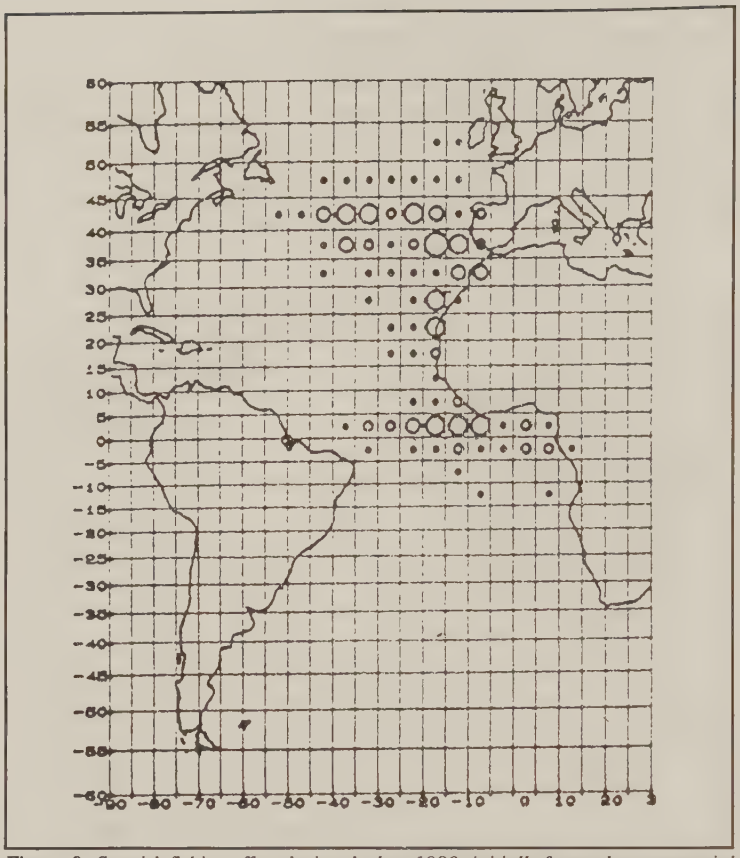


Figure 9--Spanish fishing effort during the late 1980s initially focused on equatorial grounds in the south Atlantic off west Africa. ICCAT Reports, 1991 (I).

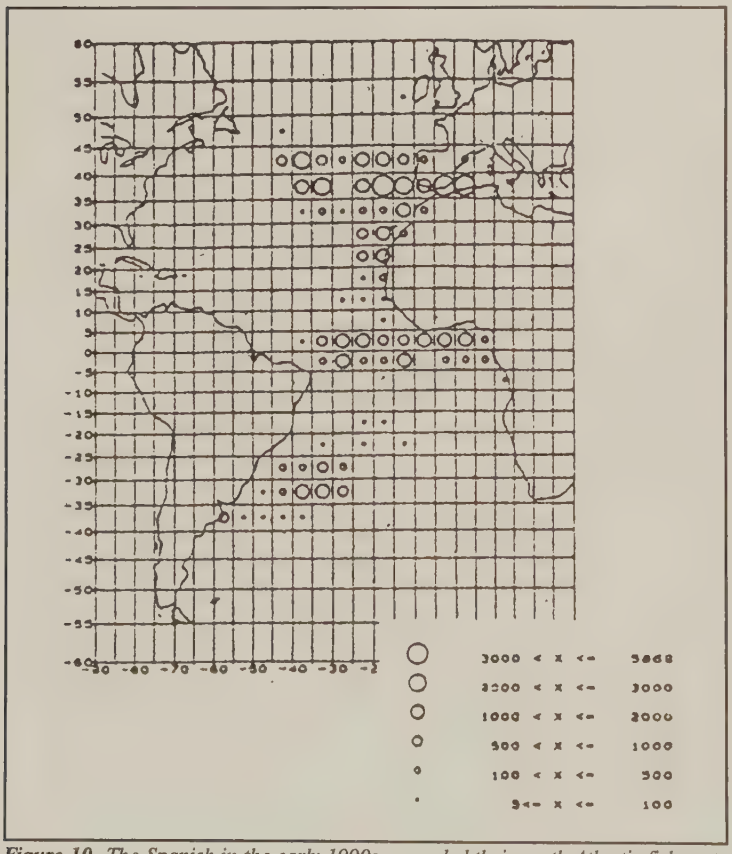


Figure 10--The Spanish in the early 1990s expanded their south Atlantic fishery to grounds off southern Brazil and Uruguay. ICCAT Reports, 1994 (I).

Taiwan: Taiwan longliners are active in the Pacific, Indian, and Atlantic oceans. Unlike the Japanese, Taiwan fishermen have focused primarily on the western Atlantic off South America, including extensive operations in the southwestern Atlantic off Brazil, Uruguay, and Argentina. The major focus of the Taiwan fishing effort at southern latitudes has been albacore, while bigeye and yellowfin are more important at equatorial latitudes (figure 11). Very substantial effort has been deployed in the southwest Atlantic off Brazil. Taiwan vessels in the 1990s have been active all along the coast, but patterns vary substantially from year to year. Seasonal fluctuations are especially prominent in the operations at southern latitudes off southern Brazil and Uruguay. While the primary focus is on tunas, billfish (mostly swordfish) are also taken. The authors do not have access to extensive annual data on Taiwan operations. Information available for 1992 showed good billfish catch rates off southeastern or southern Brazil from January to March and July through October and off northern Brazil in April (figures 12-14).[18] Taiwan

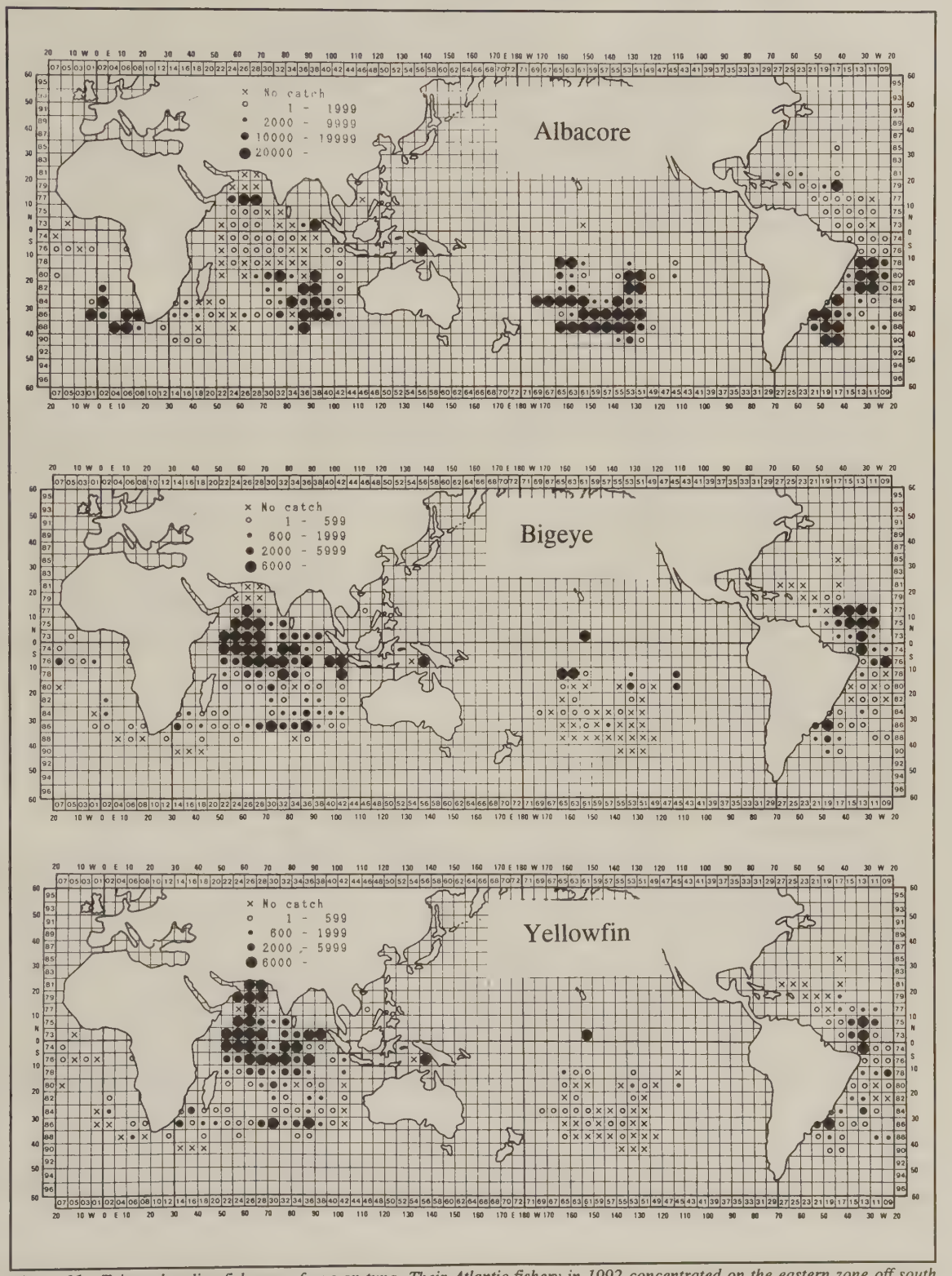


Figure 11.--Taiwan longline fishermen focus on tuna. Their Atlantic fishery in 1992 concentrated on the eastern zone off south America. Taiwan TRC

fishermen report billfish, including swordfish, being taken off Brazil's northeastern coast--especially during April. Billfish bycatches were particularly low in May and June.[19] There is considerable Taiwan tuna fishing east of the Caribbean, north of Brazil. Taiwan distant-water fishermen transship their catch through Caribbean ports. In recent years they have been particularly active at the nearby Trinidadian port of Port of Spain, having purchased part of the old National fishing Company facilities.[20]

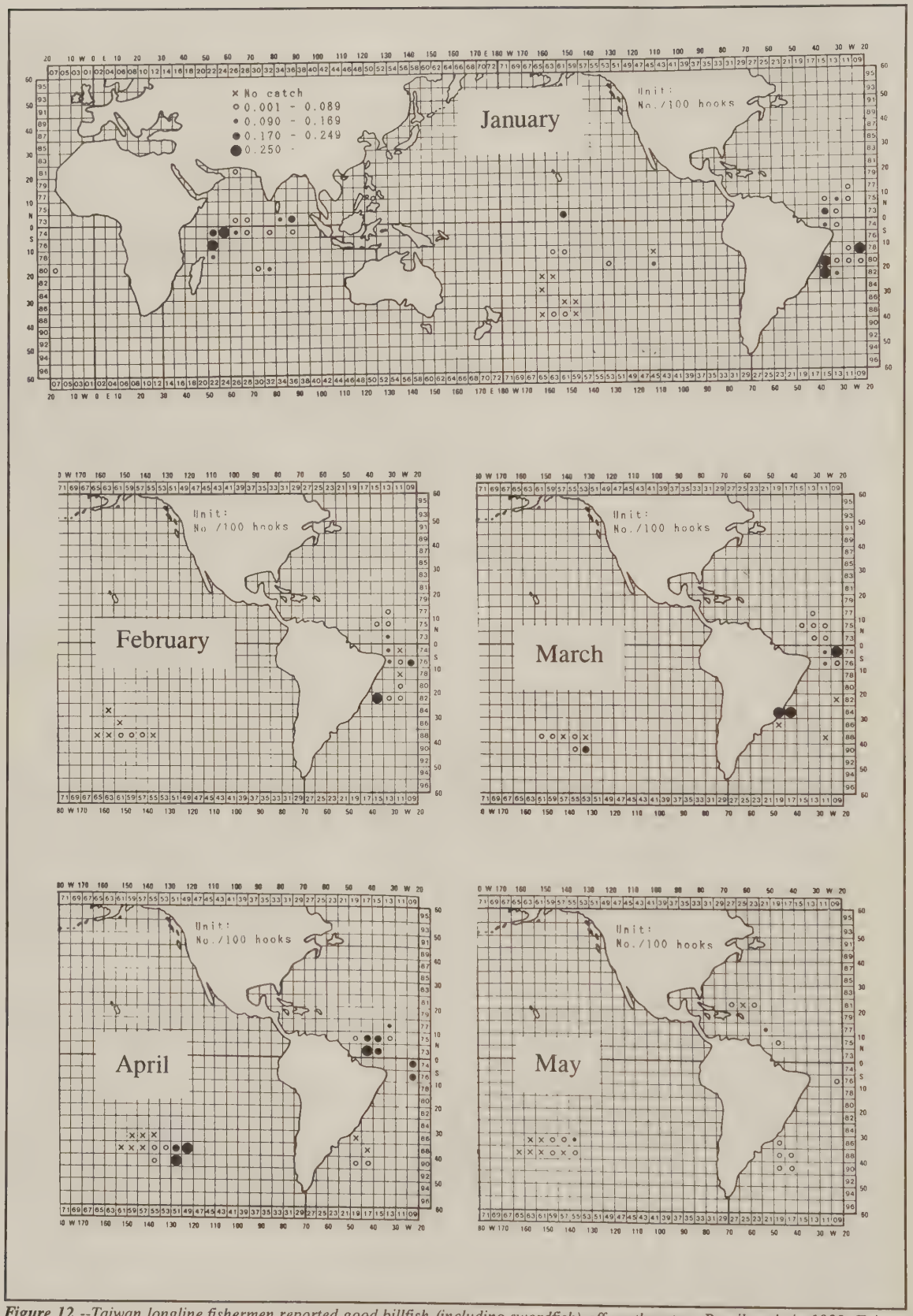


Figure 12.--Taiwan longline fishermen reported good billfish (including swordfish) off southeastern Brazil early in 1992. Taiwan TRC

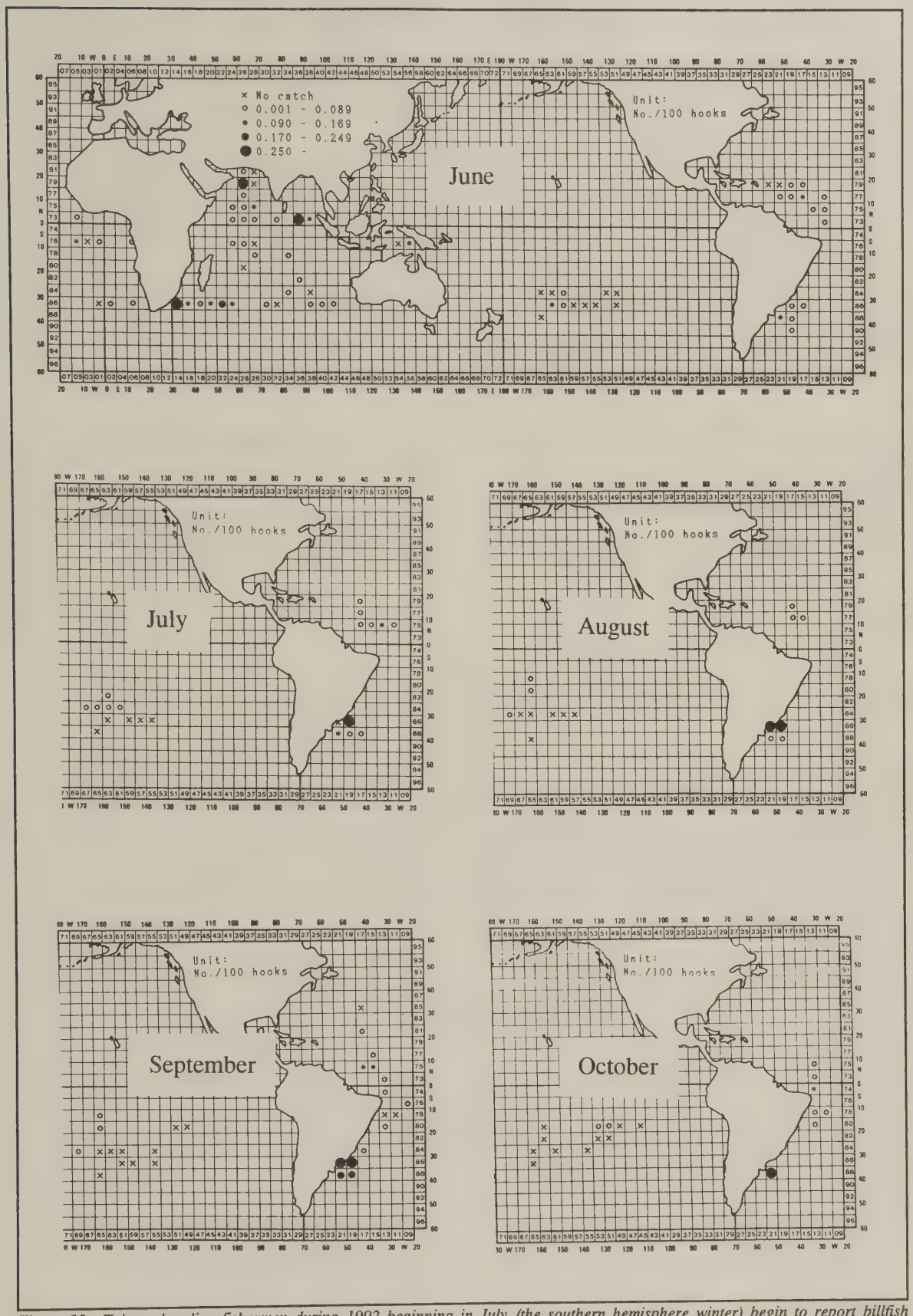


Figure 13.--Taiwan longline fishermen during 1992 beginning in July (the southern hemisphere winter) begin to report billfish (including swordfish) bycatches off southern Brazil and Uruguay. Taiwan TRC

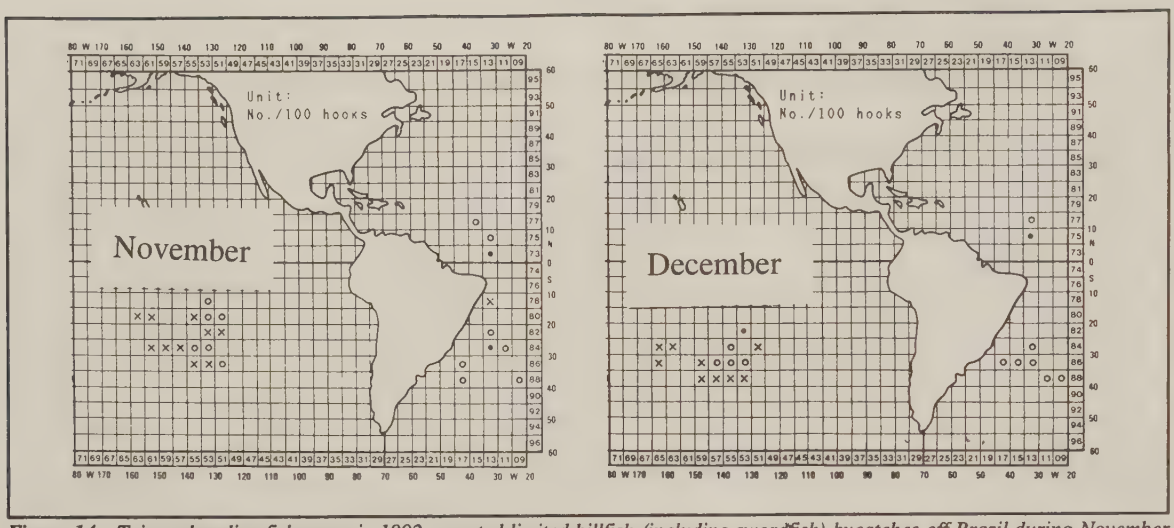


Figure 14.--Taiwan longline fishermen in 1992 reported limited billfish (including swordfish) bycatches off Brazil during November and December. Taiwan TRC

Both foreign (leased) and domestic longliners operated from Brazilian ports.

Leased vessels: One important data set on swordfish distribution off Brazil is data compiled by foreign longliners leased by Brazilian companies. Recent data from the leased vessels, many of which were targeting swordfish, show fishing activity along most of the coast south of about 3°S (except for 10°-17°S) and in offshore areas out to 10°W, especially at latitudes of 15°-30°S (figure 15). Within this range, areas of high catch rates were widely scattered. Available data for 1996-97 provides an example of the actual results

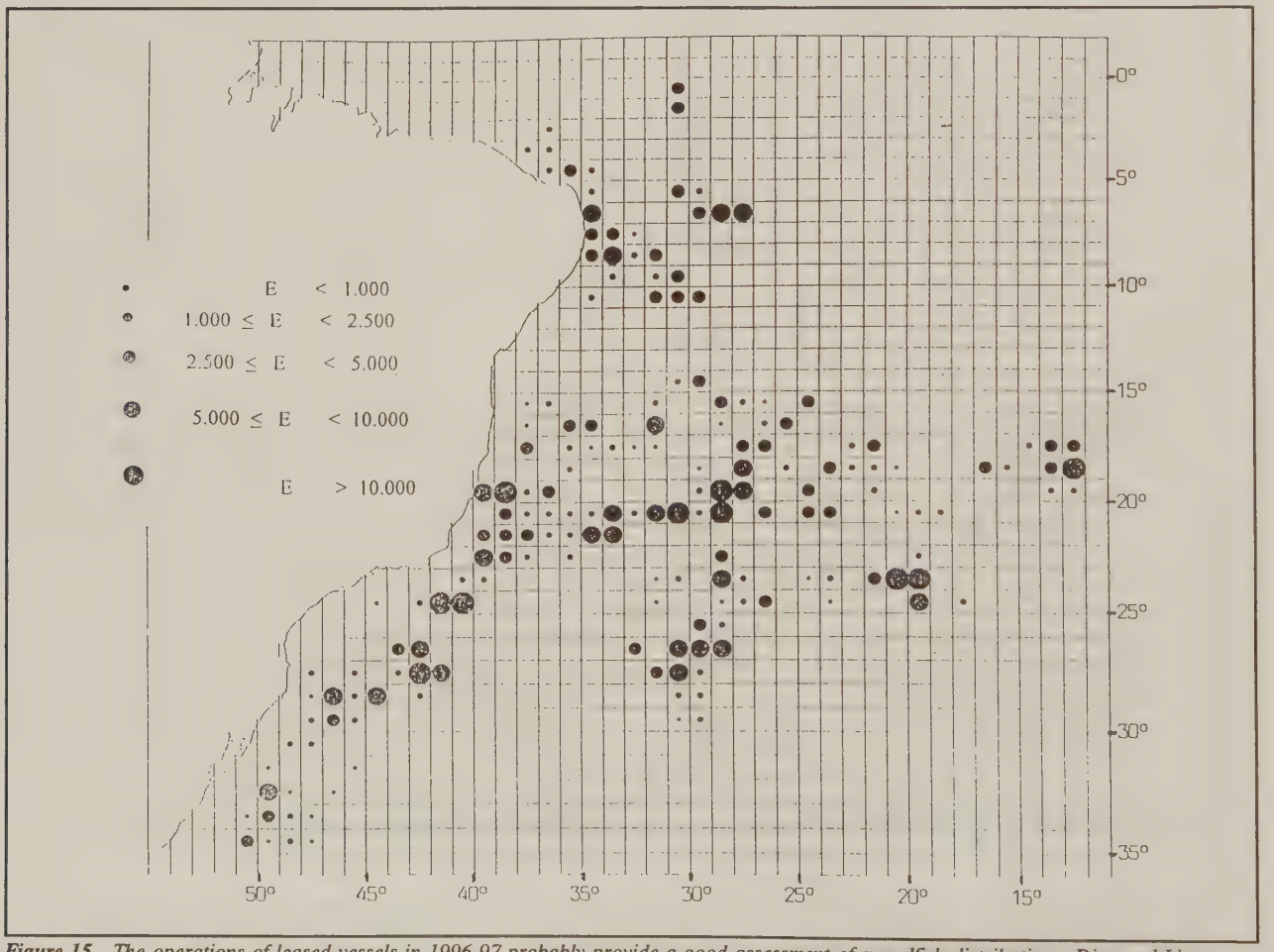


Figure 15.--The operations of leased vessels in 1996-97 probably provide a good assessment of swordfish distribution. Dias and Lima

(figure 45).[21]

Brazilian vessels: Data submitted by Brazilian vessels is being compiled by the Instituto de Pesca (IP) in Santos and the Universidade Federal Rural de Pernambuco (UFRPe) in Recife. The primary Brazilian fishing effort for swordfish has been deployed off southern and southeastern Brazil. Fishing off the northeast coast has varied, but has reportedly increased in the late 1990s. The authors know, however, of no detailed published compendium on the catch distribution of the national fleet (figure 16). Scattered fisheries data, however, provide some insights (figure 45).

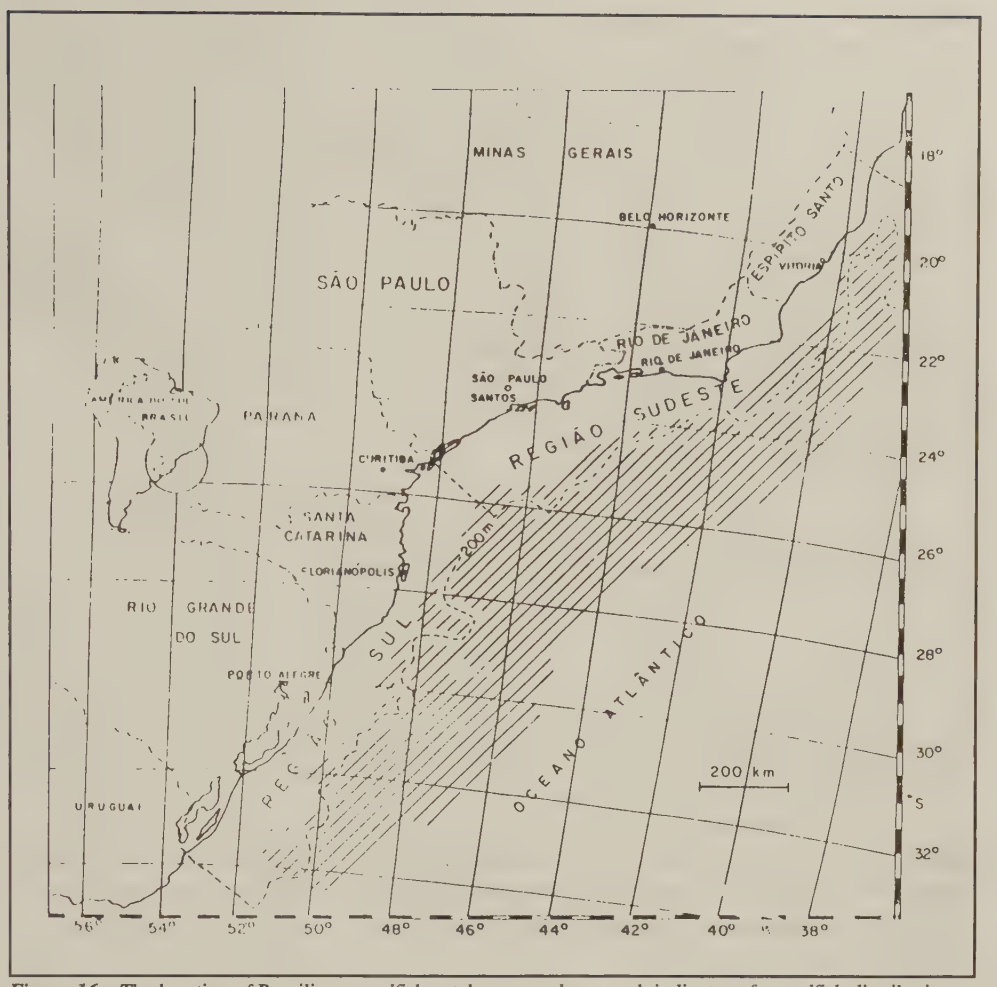


Figure 16.--The location of Brazilian swordfish catches are only a rough indicator of swordfish distribution as until recently it as a multiple species fishery. Amorim and Arfelli

B. Seasonality

Seasonal patterns are different in Brazil's northern and southern fisheries:

North: Researchers in the north report that there are no detectable seasonal fluctuations in swordfish abundance.[22] Fishing operations, however, can be seasonal as the fleet usually focuses primarily on the southern fishery. Thus the effort deployed off the northeast is in many years primarily determined by when catches begin to decline seasonally in the south. Fishing in the northeast appears to occur primarily after October and continue through April as catches decline during this period in the more important southern fishery.[23]

South: Swordfish are available off southern Brazil and the fishery is conducted throughout the year in the major fishing areas (20°-34°S and 33°-40°S). Swordfish catches peak seasonally, however, during the winter (third quarter) of the year, especially during July and August.[24] Some reports describe the best fishing in the south from June to October.[25] Tunas are also most abundant during the colder months (May to October).[26] This is the period when the influence of the cold, northerly flowing Malvinas Current is the strongest off southern Brazil and squid, a major fodder species, is most abundant.[27] (See: "Grounds".) Extensive catch collected and compiled by the Instituto de Pesca (IP) confirms that in the important southern fishery out of Santos, swordfish catch rates are highly seasonal. The IP has since 1971 compiled an extensive data base on the catch of the Santos fleet which from 1977-94 represented more 85 percent if the overall Brazilian longline catch. The IP data base includes CPUE and size frequency data. The IP reports that both absolute catches and yields (CPUEs) were highest in the third quarter. The only exception was 1987. The second highest yields were generally achieved in the second quarter during 1971-83, but more recently from 1984-94 the fourth quarter has been more important. The lowest catches were usually in February and the highest in September and August.[27A] Japanese fishermen also report that the highest catch rates are achieved in the third quarter--July-August (figure 6). Catch rates are lower in the second and fourth quarters and minimal in the first quarter.[28] One Rio Grande researcher indicates that the best swordfish fishing is usually from May through mid-September.[29] Fishing companies in Santos confirm

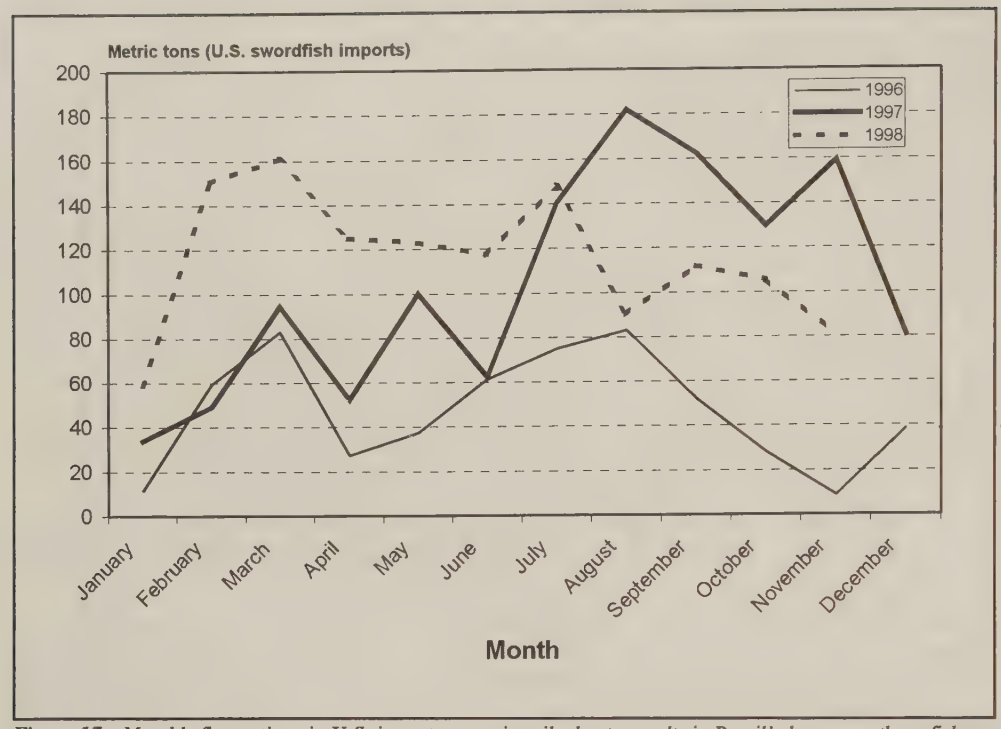


Figure 17.--Monthly fluctuations in U.S. imports are primarily due to results in Brazil's larger southern fishery. The pattern varies substantially from year to year.

there are substantial differences between Brazilian catch and U.S. import data. The authors have not yet been able to fully explain these discrepancies. Thus any seasonal pattern apparent in the U.S. import data should be treated with caution.

that the best swordfish catches (along with albacore and bigeye) are taken in the winter months (July-September) while yellowfin are taken during the summer (January-March).[30]

Some indication of seasonal patterns in Latin American export-oriented fisheries can often be discerned by assessing available U.S. import data. The U.S. is often the primary market for many Latin American fisheries for shrimp, lobster, snapper, and many other species. The United States has become almost the exclusive foreign market for the Brazilian swordfish catch. (See "Markets".) The U.S. data, however, has been of less use in assessing the seasonality of the Brazilian swordfish, primarily because there are two distinct fisheries--a tropical northern fishery and a more temperate southern fishery. Each has distinct seasonal patterns, but the U.S. import data, as it combines fish from both fisheries, is not useful in assessing seasonal fluctuations. The available seasonal U.S. import pattern since 1990 usually shows a decided peak in shipments during the second half of the year, especially August and September, and then a pronounced decline by November and December (appendix G2g). In general this appears to reflect the seasonal pattern of the larger southern fishery. Substantial variations, however, can occur in years when increased effort takes place off the northeast as seems to have been the case in 1998 (figure 17). The authors caution that

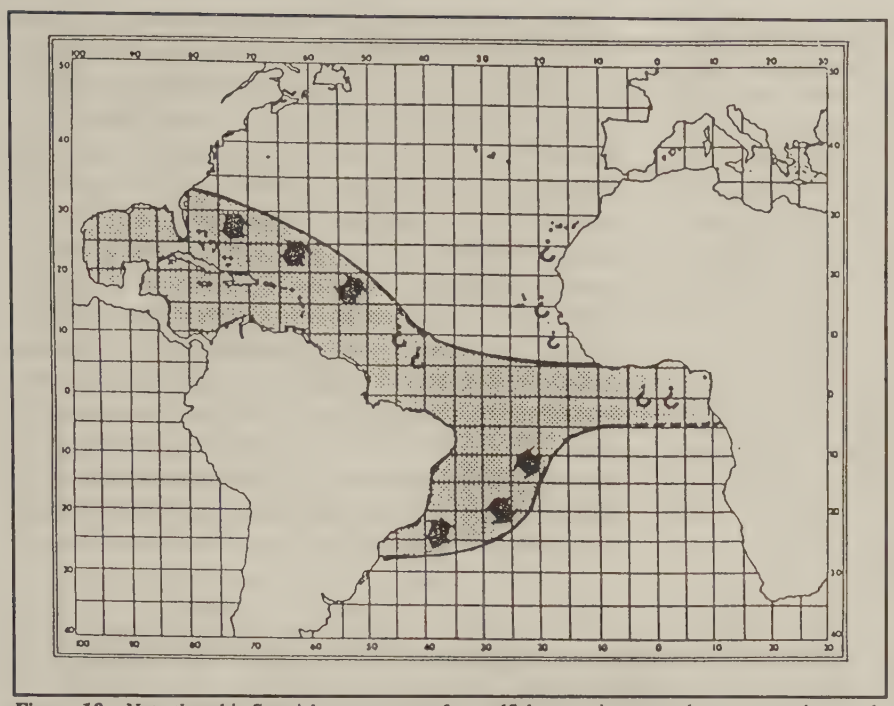


Figure 18.--Note that this Spanish assessment of swordfish spawning areas has put question marks in the eastern south Atlantic. Mejuto and Garcia

year, generally in waters deeper than 200 meters (m).[31] Swordfish occurring at higher/lower latitudes presumably make extended annual migrations during the winter months to warmer water where they spawn. One biologist reviewing the available literature of Atlantic swordfish concluded that swordfish spawning appears to be restricted to areas with water temperatures ranging from 23°-26°Celsius (C).[32]

Considerable information has been compiled identifying spawning areas in the north Atlantic. This is less true for the south Atlantic where there is a general paucity of data. The available information about preferred water temperatures for spawning can be used to identify likely areas off Brazil. Spawning may occur throughout the year at latitudes of 10°N-10°S but is probably limited to the warmer summer months (December-March) in the area to the south of 10°S off Brazil's southern coast.[33]

C. Spawning

Spawning behavior of oceanic pelagics is virtually impossible to observe. Thus spawning has to be deduced by other more easily obtainable data. Some of the best indicators of spawning are the presence of mature females with ripe gonads, concentrations of males or the concentration of eggs and larvae. The presence of large numbers of juveniles also provides useful information. Swordfish appear to spawn in warm waters at tropical and subtropical latitudes throughout the

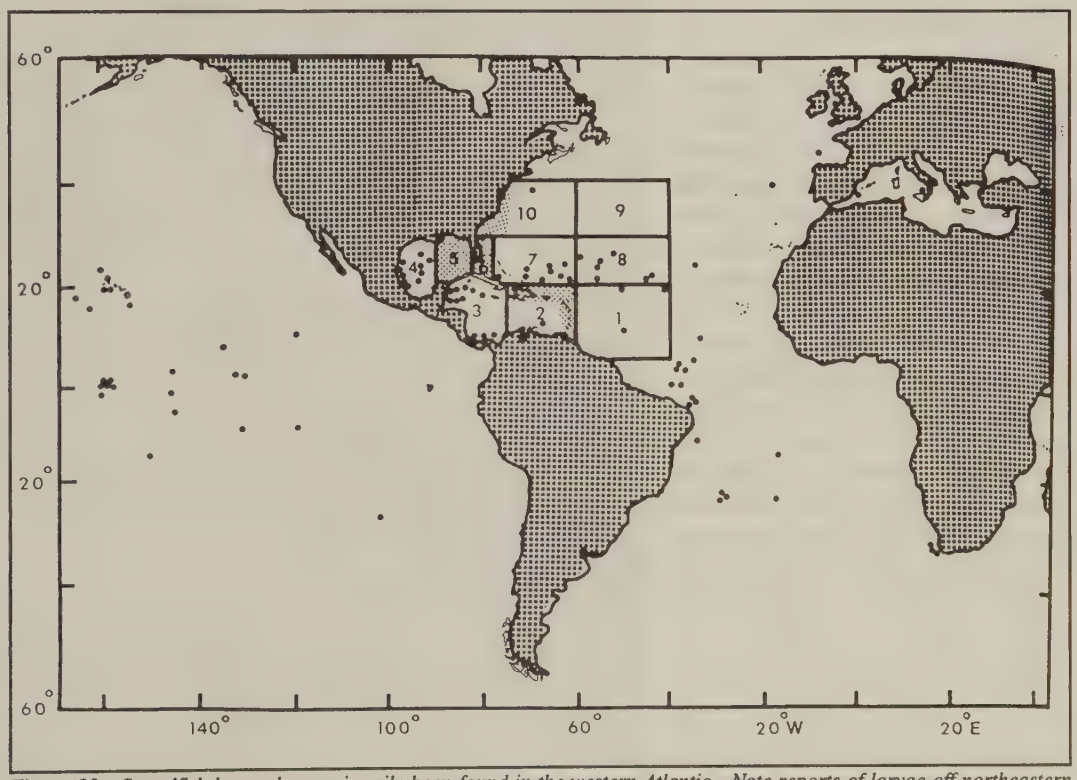


Figure 19.--Swordfish larvae have primarily been found in the western Atlantic. Note reports of larvae off northeastern Brazil. Grall, de Sylva, and Houde.

Researchers warn that swordfish larvae sometime do not show up in larval studies because of their behavior in early stages of post-embryonic development. Swordfish larvae appear to stay very close to the surface although there is some discussion among researchers on this issue.[34] Larval sampling with nets have to take spatial distribution into consideration. Some researchers have used studies of stomach sampling of fish preying on larval swordfish as a sampling technique to validate net sampling.[35]

Less information is available on the south Atlantic than most other areas. This is in part due to the recent development of a large directed fishery as well as the relatively weak ocean research programs of the coastal countries in the tropical south Atlantic.

Some of the first comprehensive larval assessments of swordfish used data compiled by Danish research cruises in the 1950s. This work was financed by United Nation's Food and Agriculture Organization (FAO) and included cruises in the south Atlantic as well as other areas. The resulting data have been used by many researchers.[36] Much of the work, however, has not been published and is not easily accessible.

1. Seasonality

Brazilian waters and adjacent ocean areas appear to be an important spawning area for south Atlantic swordfish. Spawning appears to be taking place year-round, although the authors know of no comprehensive study on larval seasonality in the south Atlantic. The first quarter of the year appears to be the principal spawning season for swordfish off Brazil, although various authors have reported different peak seasons. Seasonality varies by fishing ground with the greatest variability found, as would be expected, at the higher, more southerly latitudes off southern Brazil. Many authors have found evidence of spawning from November to April, although there are reports of spawning in other months as well. The available studies include assessments of ripe gonads, eggs and larvae, and concentration of males. Much of the available larval data comes from Soviet and Japanese research. An excellent summary of the available data has been compiled by a Instituto de Pesca (IP) researcher.[37] Future work on the seasonality of south Atlantic swordfish spawning could provide valuable insights on stock structure.

Gonad studies: Various gonad studies have found the greatest spawning concentrations in the principal southern fishing grounds (20°-30°S and 40°-50°W) during the first quarter (January-March) of the year, and to a lesser extent in the fourth quarter (October-December).[38] Data on gonadal maturation, however, shows a somewhat mixed picture (appendix C4). Brazilian researchers have collected samples from their fleet's operations and after comparing their findings with existing literature concluded that spawning off

Photo 10--Almost all of the Brazilian and other south Atlantic data on swordfish is fishery-related data and thus must be interpreted with some caution. D. Weidner.

Brazil's southeastern coast takes place from about November to February.[39]

Egg/larval studies: Scattered swordfish larvae have been found over extensive areas of the tropical oceans. Swordfish larvae account for an extremely small proportion of the ichthyoplankton and as a result accounts of researchers finding them are relatively rare. A concentration of swordfish larvae, when found, is strong evidence of spawning activity. Various authors have suggested that swordfish larvae are associated with horizontal temperature and salinity gradients.[40] Many authors have noted a strong seasonal pattern to larval abundance. Swordfish larvae appear to be most common off Brazil from November to April, although a variety of different assessments have reported variations to this general pattern. One of the variables involved is the water temperature. Brazil has a very large coast covering both tropical and temperate latitudes with a substantial variation in water temperatures (figures 31-35). Japanese researchers have noted larvae during the warmer months (November to April) in tropical waters (0°-5°S, 34°-40°W) at water temperatures of 24°-26°C.[41] Other Japanese observers have noted swordfish larvae all along the Brazilian coast with the highest concentrations from December to March.[42] One researcher noted swordfish larvae at equatorial latitudes during November through April.[43] Other researchers have found larvae most abundant along much of the Brazilian coast (5°N-27°S) from January to March.[44] Researchers have noted swordfish larvae as far south as 30°S from November through April in 20°-30°S and 20°-30°W between the 24-24°C thermocline. One study noted the presence of swordfish larvae off the southern Brazilian coast (20-30°S and 40-50°W) during the warmer summer months (November to April).[45] A Soviet researcher reported that swordfish in the eastern Atlantic spawn primarily from February to April.[46] Brazilian researchers working with their fishermen along the central and southern coast found evidence of spawning during the fourth and first quarter.[47]

2. Area

Available data shows active swordfish spawning in the western south Atlantic along the Brazilian and at mid-ocean latitudes off Brazil. Several authors have found extensive evidence of swordfish spawning in the western Atlantic. There is less evidence of spawning along the African coast in the eastern south Atlantic. The authors have noted fewer reports on spawning in the eastern Atlantic--with the exception of he Mediterranean.

Gonad studies: Various gonad studies have found the greatest spawning concentrations in the principal southern fishing grounds (20°-30°S and 40°-50°W).[48] Data on gonadal maturation, however, shows a somewhat mixed picture (appendix C4). Brazilian researchers have collected samples from their fleet's operations and after comparing their findings with existing literature concluded that spawning off Brazil's southeastern coast is most intense in fairly coastal waters (20°-28°S, 39°-48°W).[49] A more recent study found areas with high gonadal indices of adult swordfish (over 165 cm) in mid-Atlantic waters off central/southern Brazil (15°-35°S, 20°-35°W).[50]

Egg/larval studies: Swordfish larvae have been found in all tropical waters, including the north and south Atlantic, Mediterranean and Pacific. Available studies have involved larvae and not eggs, but as the eggs hatch in only a few hours, larvae (especially small larvae) would appear to be a very good indicator of spawning.[51] Several authors have noted strong concentrations of larvae in Brazilian waters and adjacent oceanic areas. Researchers have also noted swordfish larvae seasonally at 20°-30°S and 20°-30°W between the 24-24°C thermocline. One study noted the presence of swordfish larvae off the southern Brazilian coast (20-30°S and 40-50°W) during the warmer summer months (November to April).[52] Another researcher encountered swordfish larvae in the area from 20°-30°S and 30°-40°W.[53] Japanese researchers have noted larvae during the warmer months (November to April) in tropical waters (0°-5°S, 34°-40°W) in waters from 24°-26°C.[54] Swordfish larvae have been noted as far south as 25°S, mostly in the western south Atlantic along the Brazilian coast. Some larvae have been noted at mid-ocean latitudes (25°W), but only in the southern (temperate) area of reported larval occurrence. The limited available data means that the lack of swordfish larvae in other areas is not conclusive. The presence of swordfish larvae in the western south Atlantic is conclusive, and there is a particularly large concentration in relatively coastal waters from 5°N-0° off northeastern Brazil (figure 19).[55] (Note that the south Atlantic statistical areas for FAO and ICCAT begin at 5°N.) There is some limited evidence of swordfish spawning in the eastern Atlantic off Africa. Soviet and Japanese researchers have reported swordfish larvae in the eastern Atlantic, especially in the Gulf of Guinea.[56] The reports of swordfish larvae in the western and central Atlantic are much more numerous. This may indicate more intensive swordfish spawning in the western Atlantic, but the available evidence is too limited for any definitive conclusions. Swordfish spawning in the north Atlantic does seem to occur primarily in the western north Atlantic, with the exception of the Mediterranean.[57] The situation is less clear in the south Atlantic, although there does appear to be more evidence of spawning in the western south Atlantic than

the eastern south Atlantic. One notable observation is that in the Pacific, concentrations of swordfish larvae also appear to be present in the western and central areas--but not the eastern areas along the Pacific coast (California/Mexico, and Peru/Chile).[58] Marine biologists have not yet determined why spawning does not appear to be taking place or is not as strong in the eastern Pacific and Atlantic, but the dominant cold water currents in the eastern Pacific and Atlantic could be important factors. Water temperatures at comparable latitudes are colder in the eastern south Atlantic than in the western south Atlantic (figures 31-35).[59]

Concentrations of males: Another good indicator of spawning can be an unusually large aggregation of males. The most likely explanation of significant male concentrations is the presence of females in spawning condition. Males tend to be substantially smaller than females. As a result of this difference there can be behavioral differences between the species. The larger, stronger females are more powerful swimmers and can tolerate colder water temperatures, giving them the ability to range at higher latitudes and perhaps greater depths. Thus a variety of factors need to be considered when assessing concentrations of males. Females in spawning condition, however, would appear to be the most likely explanation. One recent Spanish study suggests a very significant, but highly variable, concentration of males in the western south Atlantic off Brazil (figure 20). While variable, the difference between the western south Atlantic off Brazil and the eastern area off Africa is striking. Notably colder water temperatures occur in the eastern south Atlantic than at comparable latitudes in the western south Atlantic (figures 31-35) [60]

3. Oceanography

Some authors believe that swordfish spawning may be related to the isotherms underneath surface layers and suggest an area within the 25°C isotherm at a depth of 50 m where swordfish may be spawning. This would mean an area from about 34°N-28°S which would include practically the entire Brazilian coast.[61] Research involving swordfish behavior at various depths, however, is very difficult and expensive to conduct. Current work is very limited. The expanding development and use of archival tags, however, offers the hope of much expanded work in the future.

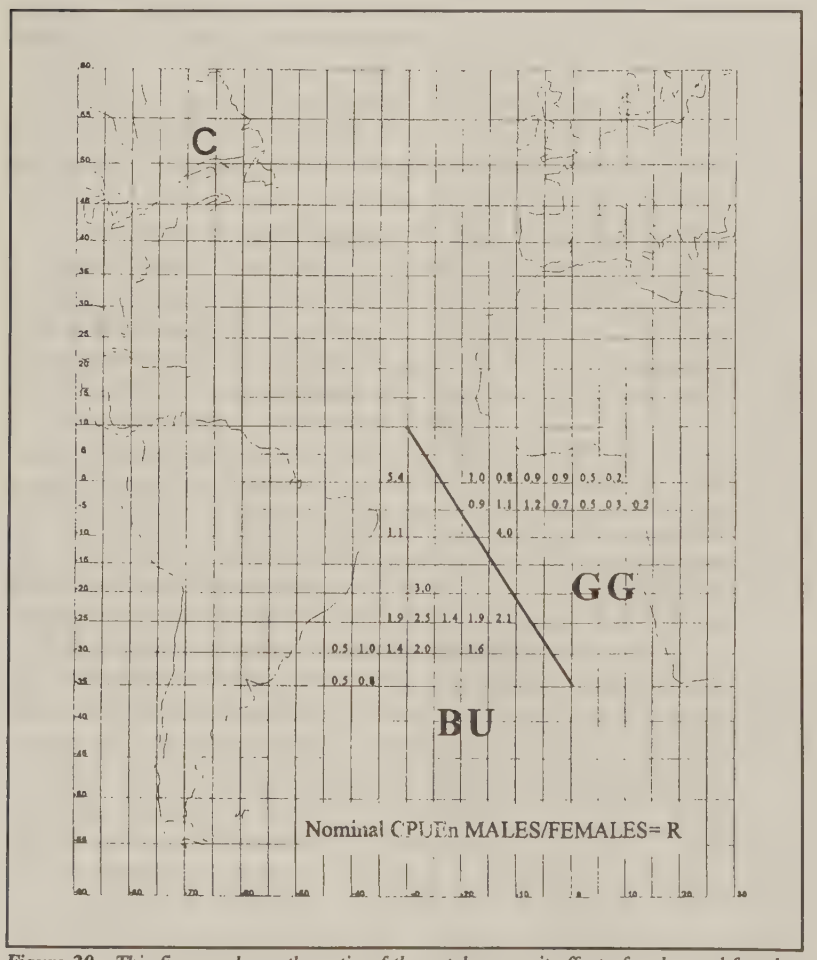


Figure 20.--This figures shows the ratio of the catch-per-unit effort of males and females. The higher numbers show a higher concentration of males. Mehuto, de la Serna, and García.

D. Feeding

Swordfish equipped with large efficient eyes and powerful slashing bills are highly effective nighttime predators. The fish appear to feed throughout the water column. They follow the daily migration of the deep-scattering layer by maintaining a position within a preferred light level (isolume). They are generally targeted by the fishermen when they rise in the water column to feed at night, making them more vulnerable to the fishery.

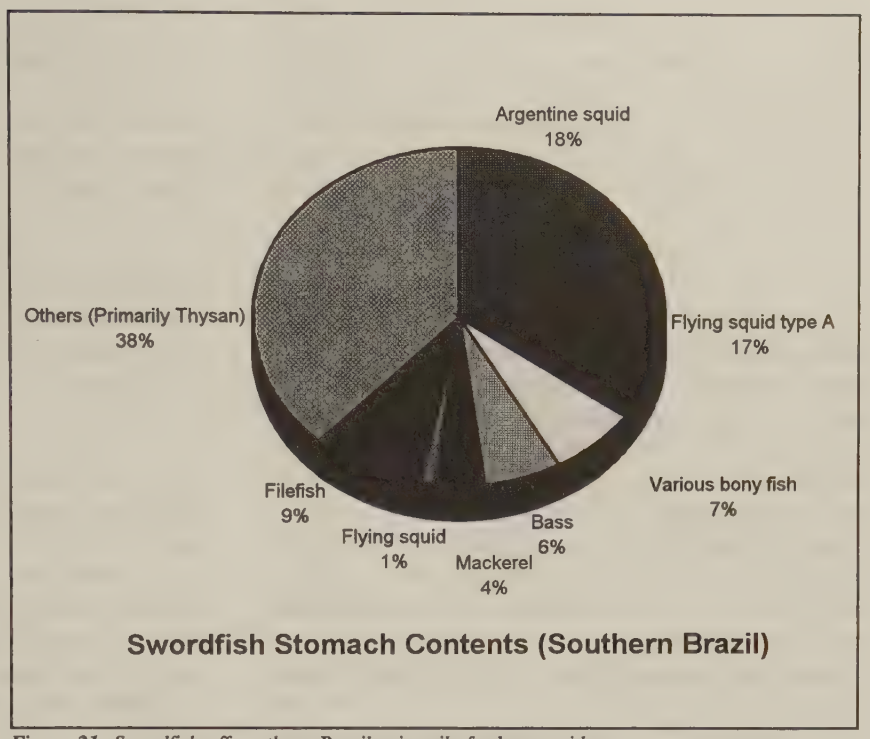


Figure 21--Swordfish off southern Brazil primarily feed on squids.

Most authors report that swordfish are opportunistic feeders, preying upon a variety of species including groundfish, pelagics, deep-water fish, and invertebrates like squid. One study suggests that large swordfish target whatever suitable species is most abundant locally.[62] Larger individuals catch the faster swimming squid species. This is most likely because the larger swordfish are capable of fast sprints capable of catching ommastrephid squid.[63] Another study suggests that the variety of prey items confirms that swordfish are opportunistic feeders.[64] Several studies have confirmed that squid is a major prey item for swordfish in other ocean areas. This also appears to be the case of Brazil, although other species are also important (appendix C3a).

Little information is available on the feeding strategies of swordfish, other than what is found in the animal's stomach after capture. It is believed that the fish's beak or sword probably plays an important role. The fish's musculature also provides helpful clues. Unlike many oceanic pelagics which have red flesh, swordfish have primarily whitish flesh. This suggests that the fish is geared primarily to generate sudden bursts of energy rather than sustained, steady cruising.[65] This probably relates, at least in part, to feeding behavior.

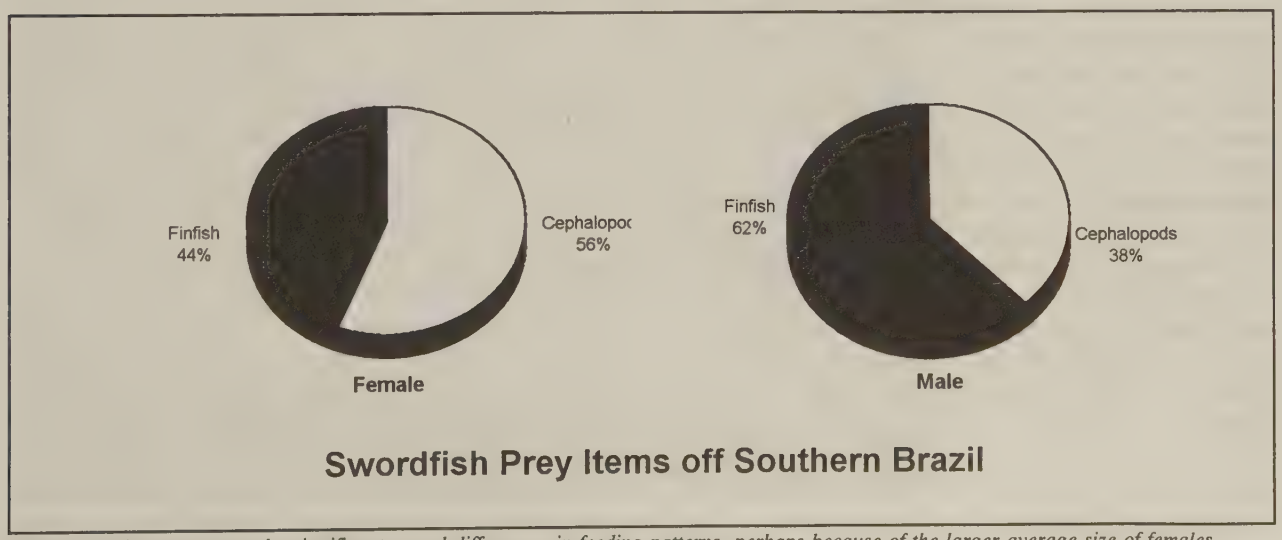


Figure 22--There appear to be significant sexual differences in feeding patterns, perhaps because of the larger average size of females.

1. Regional data

Some research and observations by fishermen is available on feeding behavior in both the northeastern and southern fishery.

a) Southern fishery

Analysis of swordfish stomach contents off southern Brazil clearly shows squid as the principal target species.[66] Some Brazilian researchers conclude that the species off southern Brazil has a strong preference for squid, but consume only minor quantities of crustaceans. The principal species targeted are squid (*Illex argentinus*) and flying squids (*Ommstrephidae*), which appear to constitute nearly 20 percent of species' diets by weight each.[67] Several other species are also of considerable importance: filefish (9 percent), *Teleosteo* (7 percent), bass (6 percent), and mackerel (4 percent).[68] Some difference is reported in feeding habits off southern and southeastern Brazil. UFRPe researchers report that the principal difference is that off the northeastern coast swordfish feed more on finfish and off the southern coast more on squid.[69] Another author reports that finfish are more important off southeastern Brazil (north of 27°S) and squid off southern Brazil (south of 27°S).[70] One researcher speculates that squid is the preferred prey item and the fish only turn to finfish when squid is not abundant.[71] One researcher reports that neritic finfish are a minor prey item off southern and southeastern Brazil, even though they are of more importance in some other areas.[72]

The abundance of squid off southern Brazil during the colder months partially explains the high longline catch rates well documented by IP researchers. ICCAT reports similar data from other fishermen operating in the south Atlantic (appendix D2a). Not only are the catch rates high, but the fat content of the fish increases as the season progresses. This significantly raises their market value as Japanese consumers prefer tunas with high fat content.[73] Much of the Brazilian longline tuna catch is marketed in the Japanese-Brazilian community, especially in the São Paulo area. Usually the Japanese Brazilian community purchases most of the tuna catch, but small shipments are also marketed in Japan. Fat content has a very significant impact on price among Japanese consumers. It is less important in determining swordfish prices because the species is mostly marketed in the United States.

b) Northeastern fishery

Brazilian researchers at UFRPe report that the stomach contents of fish taken off the northeast coast contain mostly finfish and squid. The fish are primarily various pomfrets (*Brama spp.*). The squid are a variety of species from the ommastephidae, histioteuthidae, and cranchidae families. UFRPe researchers report that the fish assessed were taken with the old Japanese-style gear, 12 hooks per basket multi-filament gear. The hooks were spaced at 40 meters.[74]

Studies of stomach contents off northern Brazil by UFRPe also show the fish are feeding on squids and bony fish. One researcher noted that after light sticks were introduced to the fishery, the composition of stomach contents changed to more bony fish. For some reason fish were being attracted to the light sticks more than squid and the swordfish were preying on the aggregation of fish.[75]

2. Seasonality

One researcher assessing the length-frequency distribution of fish caught by Brazilian longliners has found a distinct seasonal variation. Medium-sized (100-200 cm) fish predominate during much of the year with the greatest numbers of large fish (over 200 cm) taken from June to October. Smaller fish (less than 110 cm) make up an increasing proportion of the catch at the beginning and final months of the year.[76] The time frame for the catch of larger fish coincides with the southern hemisphere winter and the increasing strength of the Malvinas/Falkland Current (Uruguay, photo 11).[77] The colder water has a high concentration of squid, which appears to be attracting adult swordfish to feed.[78]

The target prey species appears to be seasonal, revolving primarily around the life cycles of the squid species. Swordfish primarily target squid during the fall and winter when it is abundant. Swordfish then target finfish (*Teleosteo*) when the squid is less abundant.[79] The prey species also varies as a result of swordfish size. This could result from the greater thermal dependence of the males (generally smaller) and the ability of the females (generally larger) to catch larger prey. Other factors, however, may have affected the data.[80] Small swordfish (75-110 cm) primarily target squid (over 70 percent). Medium-sized swordfish (110-170 cm) target both squid and finfish. Large swordfish (over 170 cm) again show a strong preference for squid. The squid species, however changes dramatically with the size of the

swordfish. The small swordfish target *Illex* almost exclusively. The large swordfish target a variety of squids, primarily Ommastrephidae, *Thysanoteuthis rhombus*, and to a lesser extent *Illex*. Prey species vary sharply depending on the depth of the water and distance from the coast.[81]

3. Sexual differences

There are considerable differences among male and female swordfish feeding patterns. The females appear to target cephalopods while the males target finfish (appendix C3b).[82] As reflected by the stomach contents (weight), the swordfish appear to feed best in the winter, full moon phase, and near the surface (appendix C3c). The smallest number of fish with empty stomachs was noted during the winter.[83] There does not appear to be a relationship between the size of the swordfish (fish above 110 cm) and the size of many of the principal prey items.[84] Differences in the quantity of the stomach contents of male and female fish and differing feeding patterns may reflect the larger size of the females.

4. Significance

One aspect of feeding behavior which merits some research is the relationship between targeted prey species and feeding behavior and the quality of the swordfish. Brazilian swordfish sells at much lower prices in export markets than fish from other Latin American countries. (See "Markets".) Importers cite a variety of quality problems. Some Brazilian companies dismiss these claims of poor quality, but other companies recognize that a problem does exist. It is unclear why the quality problems reported by some importers occur. One possibility is that the prey items off Brazil or feeding behavior impact the swordfish physically in ways that affect the quality of the flesh.

One of the common complaints of fishermen and importers is that the Brazilian catch has a disproportionately high number of fish with pronounced bloodlines. This discoloration of the flesh significantly reduces market value, especially in the key export markets. (See "Processing and Products".) The authors know of no Brazilian study assessing this problem, quantifying it or identifying patterns such as areas in which there is a disproportionately large number of fish with large bloodlines. Anecdotal accounts suggest the problem is most severe in the tropical waters off the northeast coast, but there is no known compilation of statistical data to confirm this.

Swordfish have an interesting thermo-regulatory system which may be related to the bloodlines. The blood in some other large pelagics (especially bluefin tuna) is circulated within the core of the fish's body to conserve heat. This is, in effect, a primitive warm-blooded system. While this system occurs in some tuna it is not as developed in swordfish. The body temperature of swordfish is closer to ambient water temperatures. This in part explains the behavior observed in some areas of swordfish basking in the sun at the surface, presumably an effort to warm up in the morning after feeding in cold deep water at night. Swordfish and billfish have a fairly unique system to conserve heat. Swordfish have a "brain heater" to ensure that the brain and eyes are kept warm while feeding in cold deep water where there is only the most minimal light.[85] Their thermo-regulatory system is based on the principle that it takes less energy to heat a small area than a large area. Thus while the fish's body is near ambient water temperatures, the brain ad eyes are kept warm by a mass of muscle tissue attached to each eye can

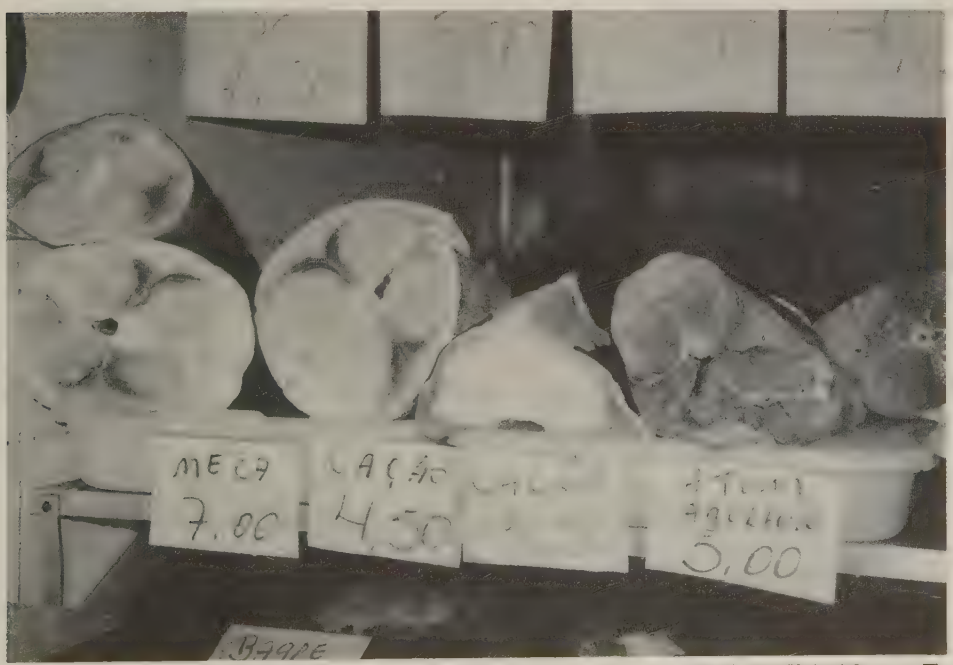


Photo 11.--Pronounced bloodlines in many swordfish lower the value, especially in the United States. The cause of the large bloodlines in many Brazilian fish is not well understood. D. Weidner

adjust the brain's temperature as the swordfish swims through water at varying depths and temperatures. This ability to rapidly move to varying depths wherever the prey is most abundant is an enormous ability to an apex predator like a swordfish. The swordfish can endure temperature fluctuations of about 30°C, an enormous range and brings the great bulk of the fish and squid species potential prey items.

Large bloodlines could be due to several factors. Water temperature and associated environmental conditions appear to be the most important factor.[86] Fish that target fast-swimming prey or that feed in colder, deeper water, for example, might develop abnormally large bloodlines to better support strenuous feeding or feeding in cold, deep water. Swordfish are opportunistic feeders, thus feeding patterns and the prey targeted in one area could be quite different than the pattern in other areas. Another possibility is a relationship to thermo-regulation. Smaller fish may have large bloodlines because the ratio of surface area to body mass is larger in smaller individuals, which means that their central core could cool more rapidly when feeding in colder, deep water than larger fish. Notably large numbers of small individuals are reportedly taken off Brazil. The authors stress that this information is conjectural and a statistical assessment of these factors is needed.

Information identifying the cause of the pronounced bloodlines could prove extremely useful to fishery managers and industry officials. While it may not prove to be caused by feeding patterns, a fuller understanding of the problem could enable managers to devise a regulatory regime to ameliorate the economic impact on the industry. It would also be helpful to industry representatives attempting to address the quality problem and low prices.

E. Maturation

Juvenile swordfish grow rapidly. Aging swordfish, however, has proven to be a difficult task for marine biologists studying the species. Biologists disagree somewhat on the appropriate methods to assess ages. In general, the fish appear to reach 140 cm lower jaw-fork length (LJFL) in about 3 years after which growth rates slow. Females grow faster than the males and reach larger sizes.[87] The females appear to reach sexual maturity at about age 5.[88]

F. Stock structure

ICCAT has established three management units for Atlantic swordfish: a Mediterranean, north Atlantic, and south Atlantic group. The north and south Atlantic group is divided at 5°N. There is considerable uncertainty, however, as to whether the north and south Atlantic management boundaries actually correspond to biological stock boundaries.

Figure 23.--The stock structure of Atlantic swordfish is still under review, but an emerging consensus points to a distinct, but not isolated northern and southern stock. ICCAT Reports, 1995 (II).

1. Tagging

Tagging programs have provided relatively little information on migratory behavior and population structure.[89] This is true of the relatively well-studied north Atlantic and even more so of the south Atlantic. Data on migratory movement of swordfish is limited because of the difficulties associated with tagging.[90]

The limited available data shows that swordfish are capable of trans-oceanic migrations. There is evidence, however, that some individuals are relatively sedentary with strong homing tendencies on feeding areas.[91] Most of the tag returns are available from the north Atlantic and only a few from the south Atlantic.[92] The limited tag returns in the south Atlantic make it impossible to assess migratory patterns for possible clues as to the stock structure.

The only Brazilian research institute tagging swordfish is the Instituto de Pesca (IP) in Santos which has been working in cooperation with the NMFS Narragansett Lab and ICCAT. Through 1993 they had tagged 49 swordfish, but only a relatively small number of returns reported by the IP. The limited number of returns so far suggests that the fish are not making long migrations, although, the few returned tags and the lack of full seasonal coverage makes it impossible to draw any firm conclusions. A swordfish tagged in May of one year and retrieved during May of a subsequent year in the same location could have made a significant seasonal migration, which would not be evident from comparing the tag and recapture locations.

The tag returns reported so far by the IP give no evidence of significant migrations by Brazilian swordfish. One juvenile swordfish (0.7 m and 14 kg), about 1½ years old, was tagged July 23, 1982, off Florianópolis was caught October 15, 1993 (2.2 m, 175 kg) off northern Argentina by Uruguayan fishermen.[93] Two other tag returns in 1998 have been reported by the IP. One fish was tagged May 6, 1996, at 35°S, 52°W weighing 50 ponds. It was recovered on May 25, 1998, at 28°S, 48°W.[94] Data on the other recovery is not yet available.

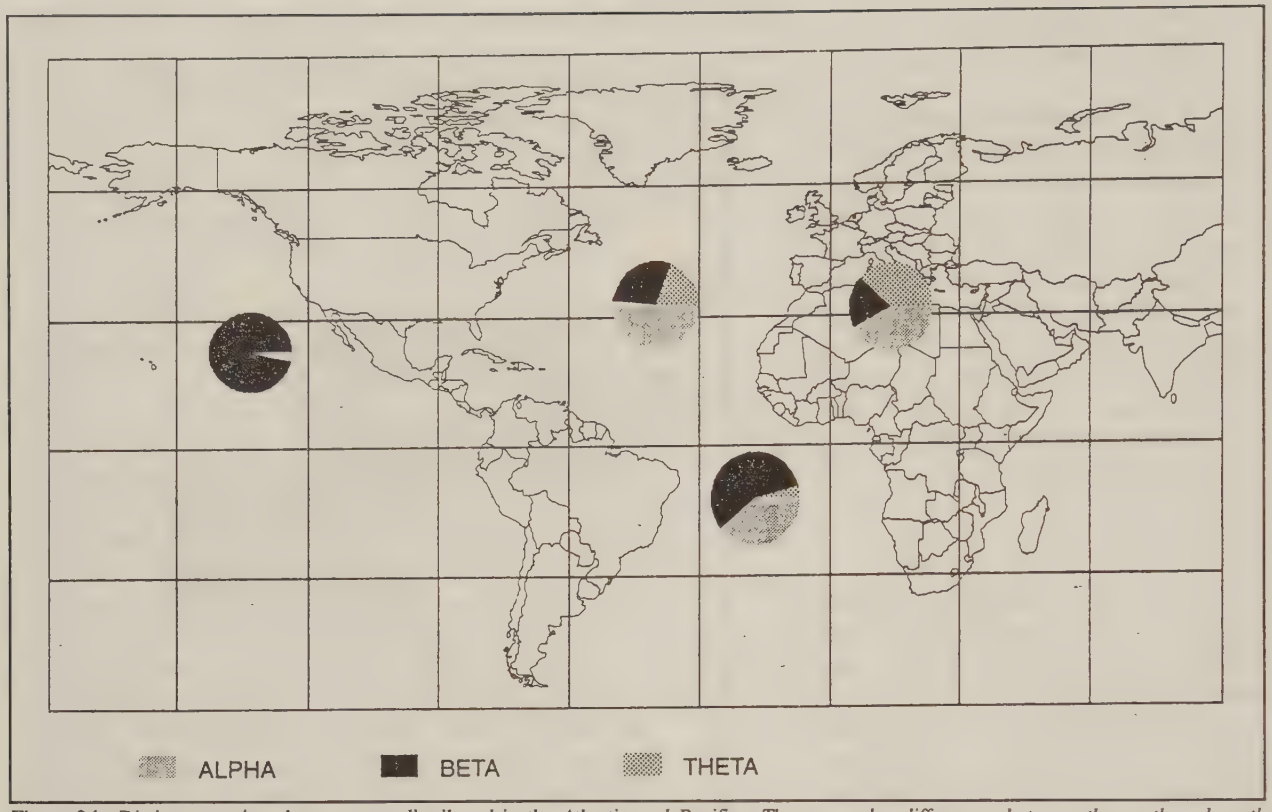


Figure 24.--Distinct genetic subgroups are distributed in the Atlantic and Pacific. There are also differences between the north and south Atlantic. Alvarado Bremer et. al.

2. Genetic work

Genetic work currently underway offers some insights into the possible stock structure. Several research groups are conducting genetic studies to better understand the stock structure and gene flows. Available assessments are still preliminary and based upon only a small number of samples. Both Spanish and American researchers have done some interesting genetic work. NMFS has contracted Stanford researcher Barbara Block who along with Patricia Rosal at the University of New Hampshire is working on swordfish genetics. Preliminary results reported in 1995 suggested that worldwide there are two deeply divergent clades with different geographical distributions, similar to certain istiophorid billfish. Genetic tests revealed significant geographic partitioning among the three ocean basins, indicating that swordfish are structured on a global basis. There appear to be exchanges between the Atlantic and Pacific-Indian Ocean basins, probably around the tip of South Africa (35°S) because this would be at latitudes and water temperatures within the normal species range. The southerly passage around the tip of South America (55°S) is less likely as it would be at latitudes beyond normal ranges.[95]

Another group of American and Spanish researchers has found significant genetic differences (haplotype frequencies) between Pacific, north Atlantic, south Atlantic and Mediterranean swordfish (appendices C5a-b).[96] This suggests the possible existence of separate north and south Atlantic stocks. Determination of the stock structure is essential for effective management. Genetic differences in fish species can not always be used to demonstrate separate stocks, but some researchers believe that genetic differences (the control region of swordfish mtDNA) is extremely useful for resolving stock structure.[97] The greatest differences were reported between north Atlantic and Pacific fish (figure 24).[98] This suggests possible exchanges between Indian Ocean fish (strongly related to Pacific fish) and south Atlantic fish. Other researchers believe that south Atlantic swordfish may be an isolated stock.[99] Some researchers have speculated about seasonal differences in the genetic make up of fish appearing off Uruguay and southern Brazil, but warn that as of early 1997 there were far too few available samples to draw even preliminary conclusions.[100] Other genetic researchers concur that there are still far too few samples to draw any conclusions about seasonal population fluctuations.[101] If seasonal differences are substantiated it may indicate the seasonal movement of Indian Ocean fish into the south Atlantic off Uruguay and southern Brazil. The

limited number of samples makes it impossible to conclusively establish seasonal variations.[102] The research has noted significant differences in haplotype frequencies in samples taken in the north and south Atlantic (appendices C5a-b).[103] This is further evidence pointing to the existence of two separate Atlantic stocks. There also appears to be seasonal exchanges in the south Atlantic with Indian Ocean swordfish.[104] The South American continent extends so far south that there is probably no significant exchange with Pacific swordfish. The African continent does not extend as far south and the waters off southern Africa are temperate enough that swordfish could move back and forth between the two oceans.[105]

3. Other data

Some other insights on stock structure can be obtained from fishermen. Fishermen operating off Brazil, as well as in other areas, report that they often encounter fish of striking similarity over areas of 50-300 kilometers. Within these areas the swordfish harvested can share many easily observable similarities: body shape, diameter, parasitic infestations, and other characteristics.[106] This suggests some sort of local group affinity. While widely reported by fishermen, it has not been well studied by marine biologists. The social structure, persistence over time, and migratory movement of these groupings are unknown.

G. Migration

Data on swordfish migration off Brazil is extremely limited. Migration can only be determined with certainty by tagging, but tagging efforts off Brazil have been very limited and actual returns even more scarce. Some available information, however, offers clues.

Tagging: The Instituto de Pesca (IP) in Santos has done some limited tagging. Some of the tagging has been done in cooperation with NMFS and ICCAT researchers. No conclusions can be drawn from the small number of returns, but there is as yet no evidence of trans-oceanic migrations. The few returns only show north/south movement in relatively coastal waters. One fish tagged off southern Brazil was taken 11 years later in the same area (Uruguay/northern Argentina) at about the same time of year. This means that the fish may have migrated seasonally, but it is impossible to determine. It could also mean the fish did not migrate.[107] Two additional swordfish tags have been recovered in 1997. One shows a similar movement north and south in relatively coastal waters.[108] Data on the second is not yet available.

Spawning behavior: The tendency of swordfish to spawn in warmer waters suggests, at least for fish found off the southern coast, annual seasonal migrations to warmer water. Subsurface temperature fluctuations, however, may affect spawning behavior. Mapping surface temperatures provides some information, but spawning is not simply related to surface temperatures. (See "Spawning".)

Genetic studies: Limited genetic studies provide some suggestions about possible migration behavior. One Spanish researcher found some indication that the genetic types of swordfish found off southern Brazil/Uruguay varies seasonally. This suggests a movement of fish north and south along the coast and the replacement seasonally with Indian Ocean fish. The number of fish observed, however, is very limited and defining migratory movements based on the preliminary genetic work is highly speculative. (See "Stock Structure")

H. Other biological information

Researchers report various findings concerning the sex ratio of the fish taken in the fishery. IP researchers in Santos report roughly equivalent catches of female and male swordfish are taken off Brazil, noting a female to male ratio of 1.14:1.00.[109] More recent work based on 455 fish caught on research cruises indicated a somewhat higher predominance of females, 1.23:1,00.[110] A FURG researcher working off far southern Brazil reported much higher catches of females, noting a female to male ratio of 2.9:1.0, but the study covered a more limited time period and sample.[111] This would correspond with data from other swordfish fisheries which indicate that more females are found at higher/lower latitudes when the water is colder. As females tend to be larger, they can withstand a greater temperature range than can the smaller males, which tend to avoid colder water. A FURG researcher working off southern Brazil reports that the relatively uniform depth ranges and seasonal feeding pattern suggest that different year/size classes are not segregated seasonally or spatially (by depth).[112]

One FURG researcher working off the southern coast reports that most of the swordfish taken in the fishery off southern and southeastern Brazil are fish from 2-5 years. The oldest fish is believed to have been about 18 years old.[113] Another group working with the IP out of Santos reports that most of the swordfish catch (about 75 percent) is between 90.1-100.0 and 160.1-170.0 cm eye fork length (EFL).[114]

Japanese researchers reported that the size of swordfish taken off Brazil declined in the 1980's (appendix C1b). ICCAT has published IP data through

Photo 12--Fishermen report that the average sizes of the swordfish being landed are declining. D. Weidner.

1992. The IP is currently preparing an updated data series through 1998. Anecdotal reports by fishermen, however suggest that sizes are also declining in the 1990's.

I. Stock status

1. Swordfish

The stock status of large oceanic pelagics like swordfish are difficult to assess. This is especially true of swordfish as biologists are still not sure of the stock structure or even if north and south Atlantic fish are a separate stock. Much of the available data comes from a fishery (Japanese longline tuna fishery) in which swordfish was not the principal target species. It is clear, however, that given the migratory nature of the fish that the stock status can only be defined over the whole range of the species and not just off Brazil or any other country. Even without firm conclusions on the stock structure, available estimates on biomass and fishing mortality in the south Atlantic give considerable cause for concern. The swordfish biomass in the south Atlantic, as of 1995, has declined 50 percent from 1960 with more than half that decline coming since 1987 when Spanish fishermen began shifting effort from the north to the south Atlantic.[115] ICCAT efforts have not yet successfully addressed this problem, despite a decision to cap south Atlantic catches at 1993-94 levels. South Atlantic catches actually increased to a record 20,600 t in 1995, but then declined slightly to 18,000 t in 1996 (appendix E3a4). This is still well above minimum levels suggested by ICCAT scientists.

The ICCAT Standing committee on Research and Statistics (SCRS) is "seriously concerned" about the status of south Atlantic swordfish stocks. Two trends give cause for alarm. First, the results of the preliminary south Atlantic production model project a clear future downward trend. Second, there is a pattern of high catches and declining yields in some fisheries. Both the 1995 and 1996 catches exceeded all previous catch levels despite the 1994 ICCAT cap (appendix E3a8). They are at the same level of peak catches once observed in the north Atlantic. SCRS researchers stress that the results of the preliminary analysis indicate that "current levels of harvest are not sustainable". The SCRS further recommended that to maintain a healthy stock, ICCAT through its members, should not delay actions to reduce harvest levels. Delays would mean that even more restrictive future measures would be required. The SCRS suggested that "the level of harvest needs to be immediately reduced below the level of the estimated replacement yield" (appendix D2a)[116]

a. Available data

No comprehensive data is available on longline fisheries specifically targeting south Atlantic swordfish stocks. Some multi-year data bases from multiple-species fisheries, however, have been collected by both the Japanese and the Brazilians. The data from other countries is less readily available. Even the detailed Japanese and Brazilian data cannot be easily used to assess swordfish stocks. Significant fluctuations have occurred because of changes in fishing gear and strategy. The Brazilian fishery is a multiple species fishery in which the markedly target species and directed effort have changed from year to year, depending in part on economic rather than fishery considerations. Thus declining or increasing yields in any given year could result from a variety of factors, including the introduction of new gear and methods or economic strategies rather than stock fluctuations.

1) Japanese data

The results reported by the Japanese in the south Atlantic are available for several years. They are the most extensive, longest data set available on longlining covering virtually the entire Atlantic. The Japanese data, however, can not easily be used to plot stock trends. The Japanese fishery is a multiple-species fishery. The Japanese fishermen are highly sensitive to economic factors and adjust fishing strategy, including target species, to market trends.[117] The periodic fluctuations in swordfish yields reported by the Japanese may have resulted from changes in fishing effort and strategies rather than the availability of the fish. Thus catch-per-unit effort (CPUE) data may reflect changes in market strategy rather than actual trends in the stock. An assessment of catch data during the 1990s is not available, in part because the number of Japanese vessels participating in the fishery out of Brazilian ports declined sharply in 1991 to only 1-2 vessels (appendix A1c). The Japanese data, however, does appear to show some trends.

Size: The Japanese have reported considerable fluctuations in the average size of swordfish harvested, ranging from 72 kg in 1980 to only 48 kg in 1984. While the size has fluctuated significantly, there does appear to be a general downward trend. The Japanese from 1978-81 reported sizes averaging 62 kg or more. From 1982-89 the size has averaged less than 54 kg or less (with the exception of 1987-88) (appendix C1b).

Individuals: The Japanese longline fishermen operating leased vessels off southern Brazil report that from the initiation of the fishery through 1991 that the number of swordfish taken has increased and peaked at over 8,000 fish in 1988 and 11,500 fish in 1990. The increase was not steady during this period and major declines were reported in 1981 (about 3,500 fish) and 1984 (less than 3,000 fish). The number of fish also declined in 1989 (less than 5,000 fish).

Yields: Available CPUE data show a somewhat different pattern. The fishermen increased the CPUE rapidly in the late 1970s, from only 50 kg (live weight) per 1,000 hooks in 1977 to a peak of over 300 kg in 1980. During the 1980s the CPUE has leveled off to a more stable range of from about 225 kg per 1,000 hooks (1987) to about 110 kg (1984 and 1989) (appendix D2f).[118]

Size: The average size of the fish taken has declined sharply since the late 1970s when the Japanese began to operate leased vessels off Brazil. They reported average sizes of about 70 kg in the early years of the fishery (1978-81). The size has since declined to about 50 kg during much of the 1980s, although larger weights of about 60 kg were reported in 1987-88 (appendix C1b). Brazilian researchers report that the size of the fish taken in the fishery is similar to the size reported in other major ocean areas, although the common sizes are slightly smaller off Brazil (appendix C1a). At least one Brazilian researcher concludes that the fishery has not significantly altered the population structure.[119] The absence of detailed time-line data, however, makes it difficult to definitively reach such a conclusion.

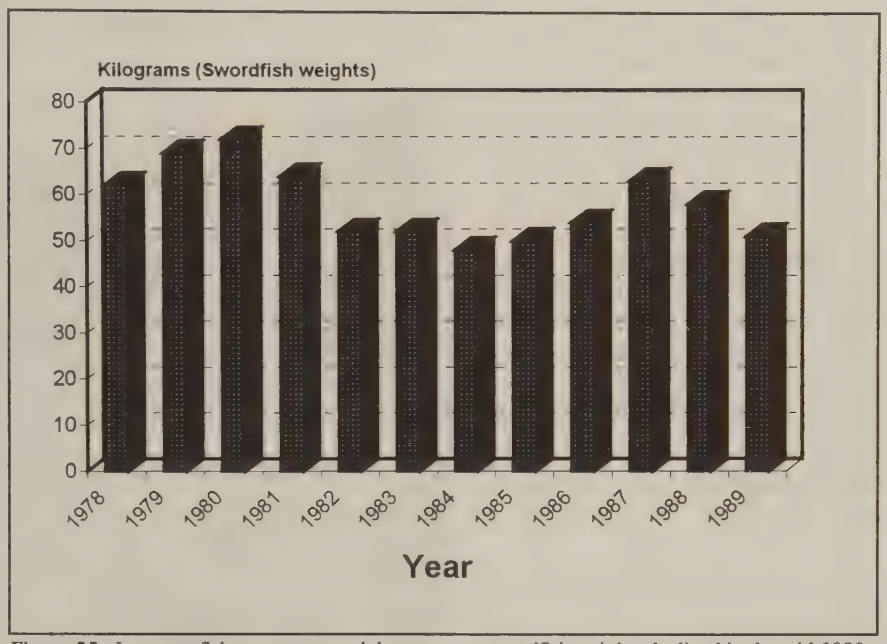


Figure 25--Japanese fisherman reported that average swordfish weights declined in the mid-1980s.

2) Brazilian data

Some companies since 1994 have reported substantial increases in yields and fish size.[120] The improved results, however, reflect the impact of the shift from Japanese to American-style longlining using mono-filament line. A very rapid shift occurred in 1994-95 to monofilament gear. By 1995-96 about half the Santos fleet had shifted to monofilament and light sticks.[121] This means that a very significant increase in Brazilian fishing effort on swordfish has occurred since the mid-1990s. IP researchers have followed this development and reported on the expanding effort and CPUE trends.

3) Spanish data

Spanish fishermen have been especially active in the south Atlantic since 1987. Spanish researchers report that the CPUE of large swordfish (5 years and older) has been declining since 1990.[122] This is a worrisome trend, especially such a substantial decline in the older fish over a relatively brief time span (figure 26). The older fish are particularly important as they are the actively spawning population. A significant decline in the mature spawners could have a potentially serious impact on future year-classes. Fluctuations in the CPUE of smaller fish are more varied and a clear pattern difficult to discern. The authors note that the CPUE of small fish (1 year) has been increasing in recent years (figure 26). This could mean increasing abundance or, more likely, a variety of other factors such as improved gear and fishing methods.

4) Other data

Taiwan and Korea have been active in the south Atlantic for years and have taken swordfish. Both countries have published some data, although the focus on other species makes the published material of limited use for assessing swordfish stocks. The authors know of no studies by either country which provide assessments of the swordfish stock. Both Taiwan and Korean fishermen in recent years have shifted effort to other species, making their data of even less importance in assessing the swordfish stock. Taiwan is, however, making some significant changes in its data collection and processing system.[123] The revised data could provide some useful information on swordfish stock trends.

b. Assessment

The available evidence, even with the deficiencies, discussed above, does appear to suggest that swordfish stocks are declining. This has caused considerable concern among fishery biologists and managers in the countries affected. The subject is receiving increased attention at annual ICCAT sessions.

The ICCAT SCRS has for several years expressed concern over the status of swordfish stocks in the south Atlantic based on increasing catches and declining yield trends in available CPUE indices. The SCRS is uncertain if the limited yield data available through 1996 has provided accurate indicators of the status of the stock. Some preliminary projections, however, give cause for concern (figures 27 and 28). The SCRS reported in 1997 that for the first time a quantitative assessment for the south Atlantic swordfish stock assumption was conducted which has yielded preliminary results. The SCRS concluded that the results of the assessment quantify reasons for concern (figure 28). The SCRS estimated that the swordfish biomass in the south Atlantic at the beginning of 1996 was estimated to be about 99 percent (range = 82-118 percent) of the biomass needed to produce the maximum sustainable yield (MSY). The 1995 fishing mortality rate was estimated at 1.24 the fishing mortality rate at MSY (range = 0.94-1.93). SCRS estimated the surplus production (estimated replacement yield) for 1996 at about 14,600 tons. With catches since 1994 in excess of 17,000 t, the current fishery substantially exceeds the replacement yield, which means that the stock is being reduced and will continue to decline until substantial reductions are made in fishing effort. SCRS concluded that in the south Atlantic, "current levels of harvest are not sustainable".[124]

Photo 13--Brazilian scientists have difficulty collecting data on swordfish because it is headed and gutted by the time it is landed. Dennis Weidner

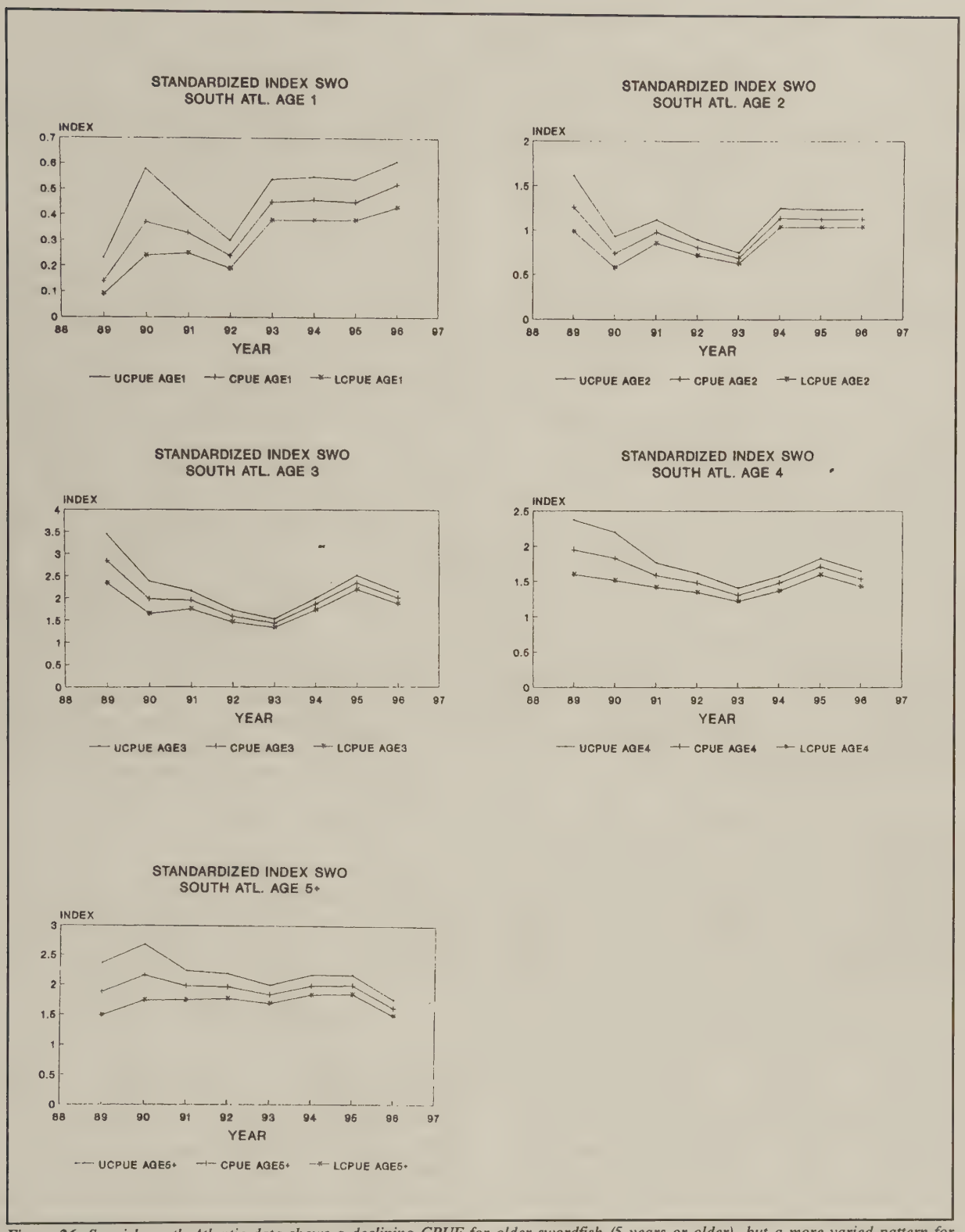


Figure 26--Spanish south Atlantic data shows a declining CPUE for older swordfish (5 years or older), but a more varied pattern for younger fish. Mejuto, Serna, and García

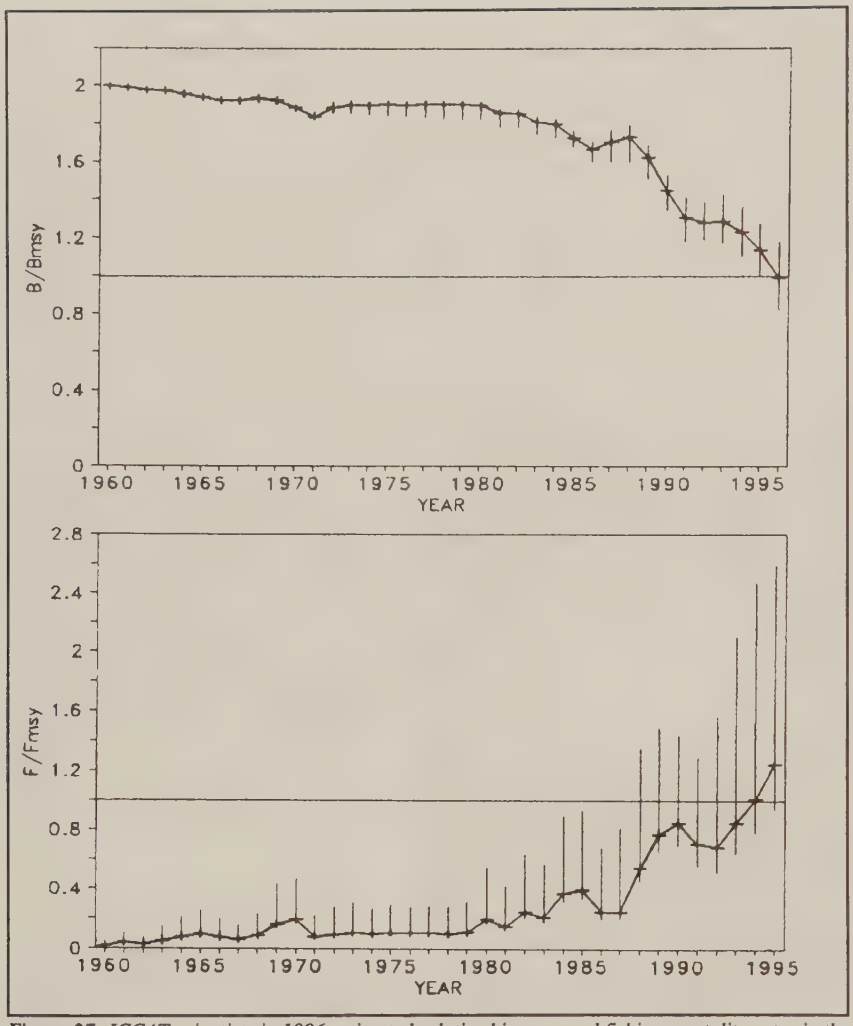


Figure 27--ICCAT scientists in 1996 estimated relative biomass and fishing mortality rates in the south Atlantic swordfish fishery. ICCAT SCRS

Brazilian officials ascribe the cause of that decline solely to the Spanish who have massively increased their effort since 1987.[125] ICCAT catch data shows the Spanish initiated significant fishing in 1988 and landed over 11,000 t in 1995 (appendix E3a1). Much of the Spanish catch was initially taken off west Africa with very small catches off Latin America. The Spanish, for example, took only 850 t in the western south Atlantic out of a total south Atlantic catch of 7,725 t during 1989 (appendices E3a1-2). The Spanish beginning in 1990 began to significantly expand operations in the western south Atlantic. FAO catch data shows Spanish catches increased from nil in 1988 to 7,300 t in the southwestern Atlantic alone during 1995 (appendix E3a2). In addition to the expanding distant-water activity, Spanish fishermen in 1996 began to negotiate access arrangements (leases) with Brazilian companies to permit operations in Brazilian waters and from Brazilian ports. This means that the Spanish in recent years have begun fishing more heavily in grounds closer to the Brazilian coast, including the southern grounds off southern Brazil and Uruguay. Spanish fishermen, however, are reducing their south Atlantic catches and they reported only 8,500 t in 1997 (appendix E3a1). A sharp decrease was reported in off Latin America, from 7,300 in 1995 to only 3,700 t in 1996 (appendix E3a2).

2. Tunas

Brazilian and foreign longline fishermen operating out of Brazilian ports target a wide variety of species besides swordfish. The fishery was initiated for tunas and the overall tuna catch significantly exceeds that of swordfish. Fishermen report substantial catches of albacore, bigeye, and yellowfin, although the importance of these species has fluctuated from year to year. Fishing effort, especially the effort exerted by the leased Japanese vessels, has varied significantly from year to year.[126] ICCAT has published a wealth of studies addressing the fisheries for tunas in the south Atlantic and describing efforts to make stock assessments.

3. Billfish

The Japanese reported substantial billfish stocks (sailfish and spearfish) in the south Atlantic, especially off southern Brazil (15°-30°S) during the 1960s.[127] ICCAT has also published a great deal of material on south Atlantic billfish.

4. Shark

Sharks represent a very significant proportion of the Brazilian longline catch. Japanese fishermen introduced a multi-species fishery and through the mid-1990s the Brazilian fishery succeeded in marketing sharks and several species are well-received on the domestic market. There is also a substantial artisanal driftnet fishery targeting sharks in coastal waters. As a result of this extensive effort, there is concern with the status of several shark species.[128] The authors, however, know of no comprehensive assessment of shark stocks. The recent shift in the strategy of many

Brazilian longline fishermen from a multi-species fishery to monofilament gear targeting primarily swordfish, appears to have reduced somewhat the pressure on offshore pelagic shark species.

J. Management regime

The International Commission for the Conservation of Atlantic Tunas (ICCAT) is the international body responsible for coordinating the management of Atlantic tuna and tuna-like species, including swordfish. Like tunas and other highly migratory species, swordfish can only be effectively managed through international cooperation over the entire range of the species' distribution. Since the mid-1980s, fishing pressure on Atlantic swordfish has increased to a point requiring international conservation and management action. In response, ICCAT has adopted various measures for both the north and the south Atlantic swordfish stocks to control fishing and to improve the condition of these over-exploited resources. ICCAT's science body, the Standing Committee on Research and Statistics (SCRS), noted in its 1998 report that the swordfish regulatory actions taken by ICCAT prior to 1996 had not been effective in the recovery of Atlantic swordfish. The SCRS further noted that the effects of more recent (1996 and 1997) regulatory measures could not be evaluated until the 1999 scientific assessment of Atlantic swordfish. While the SCRS has been most concerned about the north Atlantic swordfish stock due to its significantly over-exploited condition, SCRS has expressed increasing concern about the condition of the south Atlantic swordfish stock. The SCRS has noted that effective management is needed throughout the Atlantic to ensure conservation of the species and to allow for uncertainties associated with certain stock structure assumptions.[129]

The ICCAT SCRS also expressed concern over flag-of-convenience vessels operating in the Atlantic.[130] Some limited data is included on flag-of-convenience operations in the ICCAT data base (appendix E3a1). This appears to be, however, only limited reports on a few vessels operating off St. Helena and other locations. A much larger, but unknown number of these vessels are active in the south Atlantic. Several flag-of-convenience vessels operate under leasing arrangements with Brazilian companies. SCRS reports that "The unreported catches of non-member countries and flags of convenience fleets are of considerable concern to the Committee, as these may undermine attempts at effective regulations for conservation."[131] Several countries active in the south Atlantic have expressed considerable concern over the flag-of-convenience problem.[132]

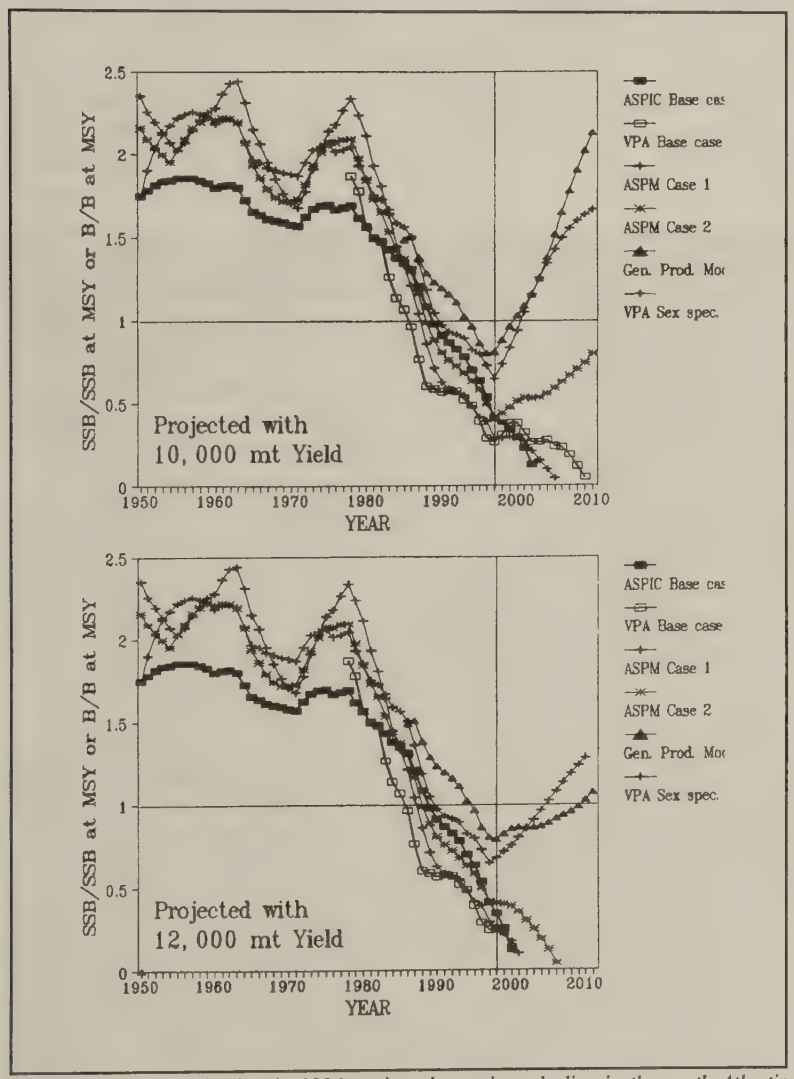


Figure 28--ICCAT scientists in 1996 projected a serious decline in the south Atlantic swordfish stock unless remedial management measures were taken. ICCAT SCRS

III. Fishing Grounds

A. Oceanography

Ocean currents help to create favorable conditions off Brazil for swordfish and tuna fishing. The current structure is much more complicated along the Atlantic coast of South America than that prevailing along the Pacific coast where the northerly flowing cold Humboldt Current dominates coastal conditions from southern Chile to as far north as northern Peru and seasonally even Ecuador. The southwest Atlantic boundary currents are much less studied than other western boundary systems.[133] In addition, the authors know of no studies assessing the impact of any of the current structures off Brazil specifically on the swordfish fishery. Available oceanographic research, however, provide a basic understanding of the dynamics creating a favorable environment for swordfish and other oceanic pelagics.

The ocean regime along the Atlantic coast of South America is primarily the result of two major current structures and the interplay between them. The warm, nutrient-poor south Equatorial current collides with the "bulge" of the Brazilian coast. This separates the south Equatorial Current into two branches; the northerly flowing Guiana current and the southerly flowing Brazil current.

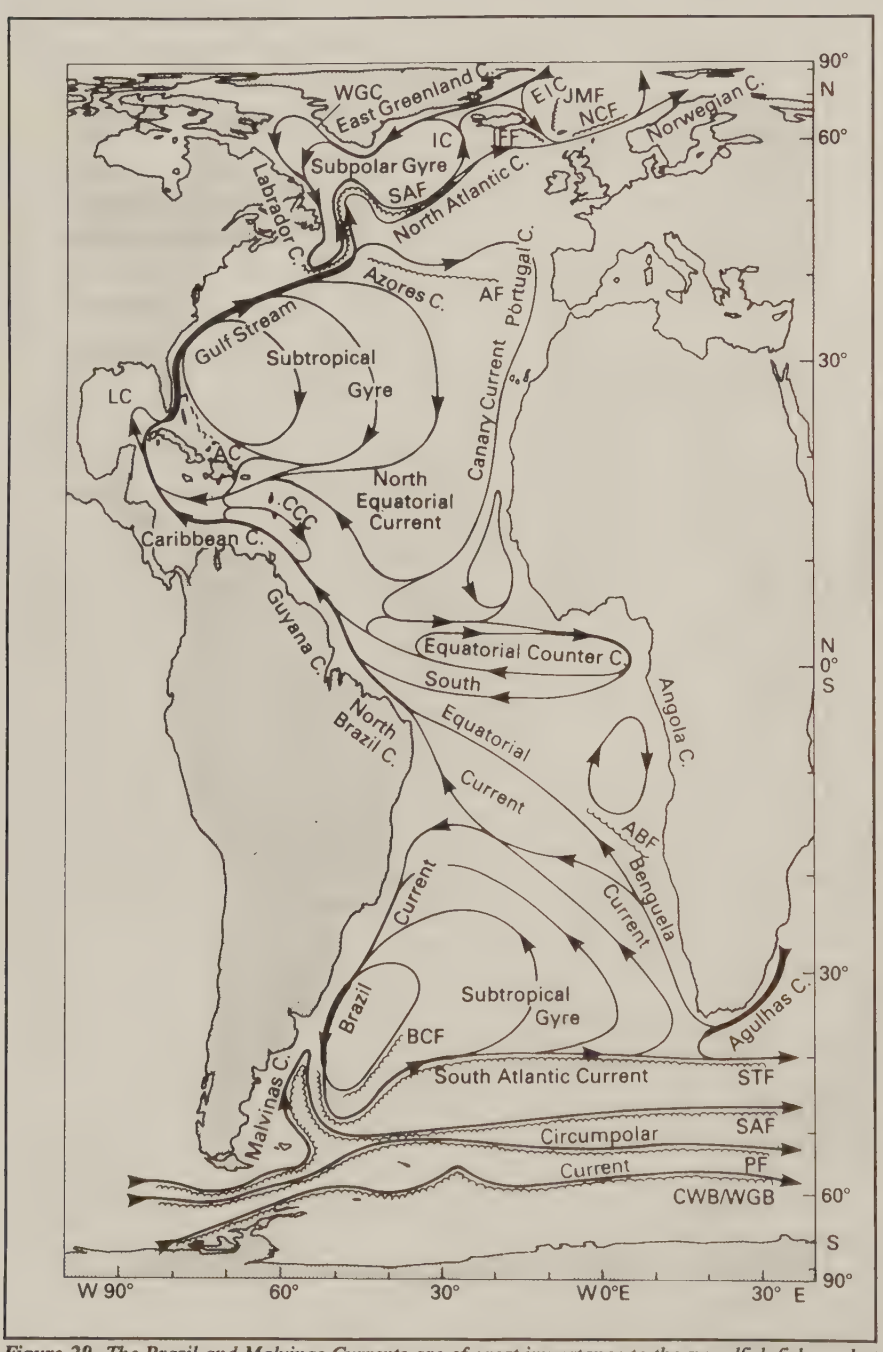


Figure 29--The Brazil and Malvinas Currents are of great importance to the swordfish fishery, but other currents are also of some significance. Tomczak and Godfrey

The southerly flowing Brazil current intersects with the cold northerly flowing Malvinas/Falklands current creating the Subtropical Convergence. This dynamic oceanic front is formed off southern Brazil and Uruguay and results in marked seasonal latitudinal displacement. The northern zone of the Subtropical Convergence influences the continental shelf and slope off southern Brazil. A mixture of warm tropical water and cold sub-Antarctic water with fresh water inputs from the La Plata estuary and the Patos Lagoon result in extremely high, but seasonal phytoplankton productivity over the Brazilian and Uruguayan shelf and slope. The presence of nutrient-rich sub-Antarctic water during the spring and winter results in high levels of primary and secondary productivity on the shelf areas off southern Brazil and Uruguay.[134] This sustains large biomasses of fodder species (anchovy, squid, and jack mackerel) for pelagic

predators like tuna and swordfish. The Subtropical Convergence, the interplay between these two currents, helps to cause of the unstable sea conditions which often attract oceanic predators such as swordfish. The meandering temperature fronts created by these currents are areas which attract swordfish.[135]

The North Brazilian Current has received relatively little attention. Much of the swordfish taken in the south Atlantic appears to be fish taken area of the Equatorial Counter Current within 5°-10° north or south of the Equator, although catches are much higher in the eastern than western zone. A similar area of high productivity is noted in the Equatorial Pacific. The huge outflow of fresh water from the Amazon has a major impact on the oceanography along Brazil's northern coast. While the Amazon outflow has been studied in some detail, the North Brazilian Current has received relatively little attention.

1. Individual currents

The most important current structure affecting the swordfish fishery is the interplay between the southerly flowing warm Brazil Current and the northerly flowing cold Malvinas/Falkland Current. Other hydrological features such as upwelling, fresh water flows, and subsurface currents are also important. Biologists are increasingly finding interactions between subsurface currents and swordfish, but this is very difficult to research and the full range of the impact of subsurface currents is not well understood.

a. North Brazil/Guyana Current

The northerly flowing North Brazil Current and the Guyana Current are a western boundary current of the Atlantic Ocean (figure 29). They are created from the division of the south Equatorial Current as it collides with the Brazilian coast. The northerly flowing stream or North Brazil Current is significantly enriched by the outflow from the Amazon. This also reduces the salinity of the current. One would envision the North Brazil and Guyana currents as a portion of a continuous northward flow starting at 16°S in the south Equatorial Current and continuing through the Caribbean into the Florida Current or Gulf Stream.[136] The flow is not well researched and some authors report that the continuity of this flow is questionable.[137] The north Brazil Current has received some attention. Some reports indicate the eddies and swirls associated with good fishing along the Gulf Stream and other currents.[138] The Guiana Current is not well documented and some researchers doubt that it is even

Photo 14.--Many Brazilian longliners still have only basic electronic equipment and are not fully utilizing the increasingly available oceanographic data to find swordfish. D. Weidner.

a permanent structure. The north Brazil Current is as deep as 150 m at the 20°C isotherm. The current comes as close as 65 kilometers (km) to the coast, but is as far as 270 km off shore where it approaches the Amazon River. The current, combined with wind patterns, creates upwelling which supports fodder species, and other conditions which attract tunas, especially yellowfin tuna. The fish appear to congregate on the leeward (western) side of St. Peter and St. Paul cays (1°N, 29°W), perhaps attracted by the resulting upwelling.[139] Beginning in July the south Atlantic High Pressure Belt gets stronger and moves a little to the northeast. The Southeast Trade Winds and the south Equatorial Current (flowing east to west) get stronger. The equatorial divergence as a result builds and water piles up in the western side of the south Atlantic. The equatorial undercurrent (flowing west to east) develops. The water around the two cays, which are in the path of both the equatorial undercurrent below the surface (about 80 m deep) and the south Equatorial Current at the surface, become very turbulent and the nutrient content in the water increases. Phytoplankton blooms occur and flying fish (*Cypselurus cyanopterus*) during October gather around the rocks to feed on the zooplankton attracted by the phytoplankton blooms. Oceanic pelagics, especially yellowfin tuna, which are migrating from northern South America to Africa, begin stopping at the cays in November to feed. Other oceanic pelagics also find the cays a productive fishing area. Longline fishermen generally report especially good fishing conditions beginning in December. The flying fish begin spawning during January and then start declining in abundance during March. The fishermen begin leaving the fishing ground in April.[140] Water conditions in these tropical waters are much more homogenous than the conditions on the southern grounds with much less pronounced temperature fronts.[141]

b. Freshwater outflows

The freshwater outflow from Brazil is so massive that it has a significant impact on fisheries kilometers out into the Atlantic. The volume of freshwater flowing from the Amazon is the greatest of any river system in the world. Other rivers are also significant, especially the São Francisco system. In addition the outflow from the La Plata estuary between Argentine and Uruguay affects southern Brazil as well. The authors, however, know of no studies assessing the impact of the freshwater outflow on the swordfish fishery. The significant freshwater outflows, however, do promote the primary and secondary productivity sustaining the fodder species upon which oceanic predators like swordfish feed.

Amazon: The Amazon river system feeds a vast volume of nutrient-rich fresh water into the Atlantic at equatorial latitudes. The influence of the Amazon can be detected as far as 300 km into the Atlantic, crossing the path and merging with the north Brazil Current. This significantly enriches the current and reduces its salinity. The Amazon outflow thus significantly alters the characteristics of the current as it moves northeast along the coast toward the Guianas. The Amazon outflow itself has been the subject of exhaustive study by oceanographers.[142]

São Francisco: The São Francisco river system drains much of central Brazil. The water transport is significant. In any virtually any other country, the São Francisco system would be the country's major river system, but in Brazil, everything pales in comparison to the Amazon.

Patos Lagoon: The Patos Lagoon along the Brazilian coast near the Uruguayan border is the world's largest choked estuary. The surface area exceeds 10,000 square kilometers. The freshwater outflow is an important contribution to the high primary productivity off southern Brazil.[143]

La Plata estuary: Much of southern Brazil is drained through the Paraguay/Paraná system which enters the Atlantic at the La Plata estuary between Argentina and Uruguay. See the Uruguayan chapter of his report for details.

c. South Brazil Current

The southerly flowing South Brazil Current (generally referred to as the Brazil Current) begins at about 10°C with a weak flow supplied by the South Equatorial Current (figure 29). Over the 1,500 km flow it acquires water from the recirculation region around the Brazil Basin (about 2-25°S). The Brazil Current by about 23°S (Cabo Frio) becomes a much stronger and more pronounced permanent feature. The Current varies from 100-190 km in width. A clearly defined recirculation cell (similar to the Sargasso Sea off the United States) south of the Rio Grande Rise (30°S, 35°W) helps strengthen the southerly flow and water transport in the Brazil Current. The Brazil Current is relatively shallow; nearly half of the flow takes place on the shelf with the current axis above the 200 m isobath.[144] The 20°C isomtherme found at 80-100 m during spring (September-November) and summer (December-February) and 100-150 m during fall (March-May) and winter (July-August). The Santos fishermen are relatively close to the current (about 150 km).[145] Surface temperatures are about 20-24°C and 17-20° at 80-100 meters. The southernmost extension of the Brazil Current after shifting from the shelf is 38-46°S, varying seasonally (figure 29).[146] Huge shifts have been noted in the thermal

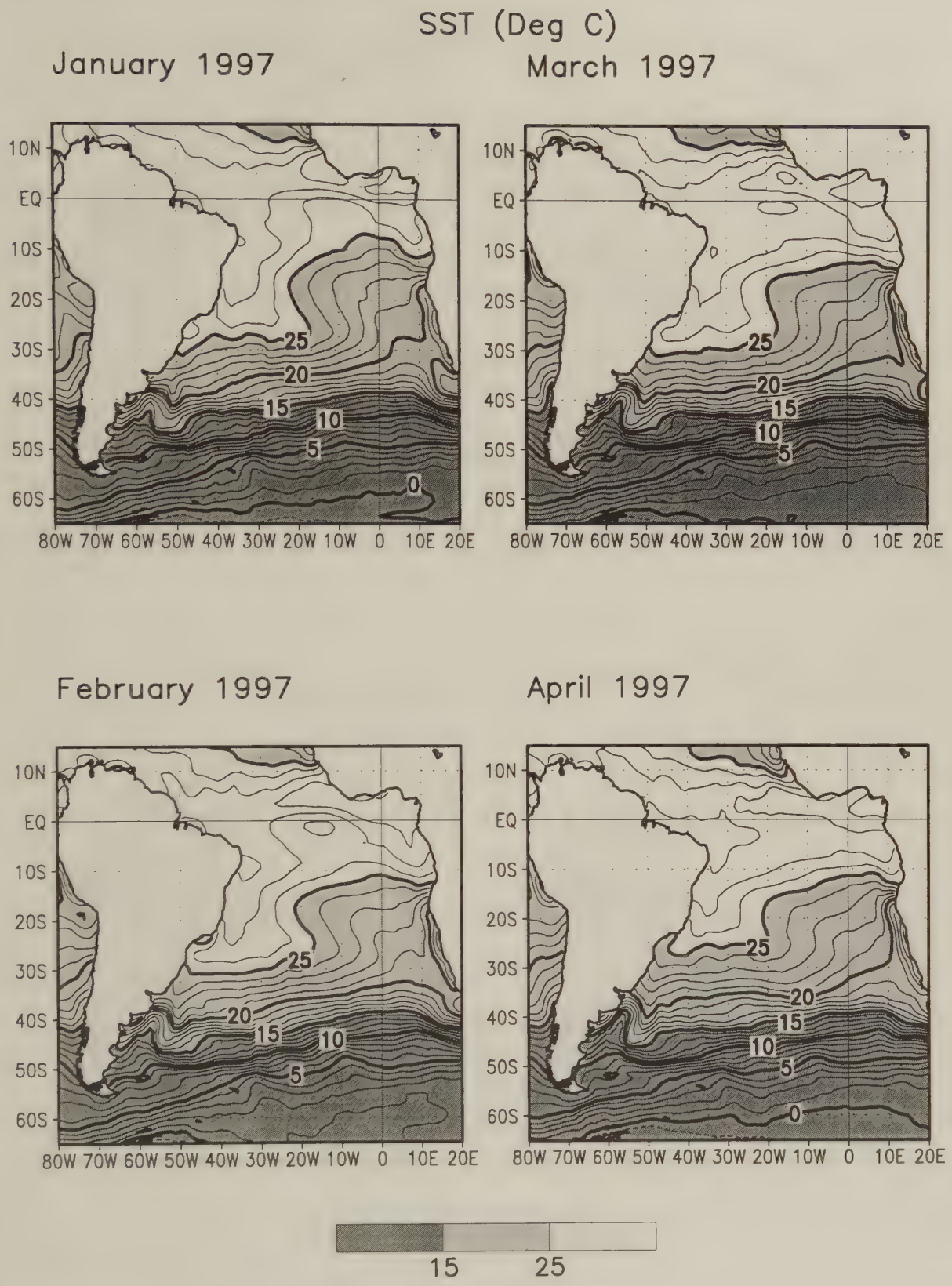


Figure 30.--Note relative stability of the temperature structure during these months, but a slight intrusion of warm water south in December. Vernon Kousky, NOAA

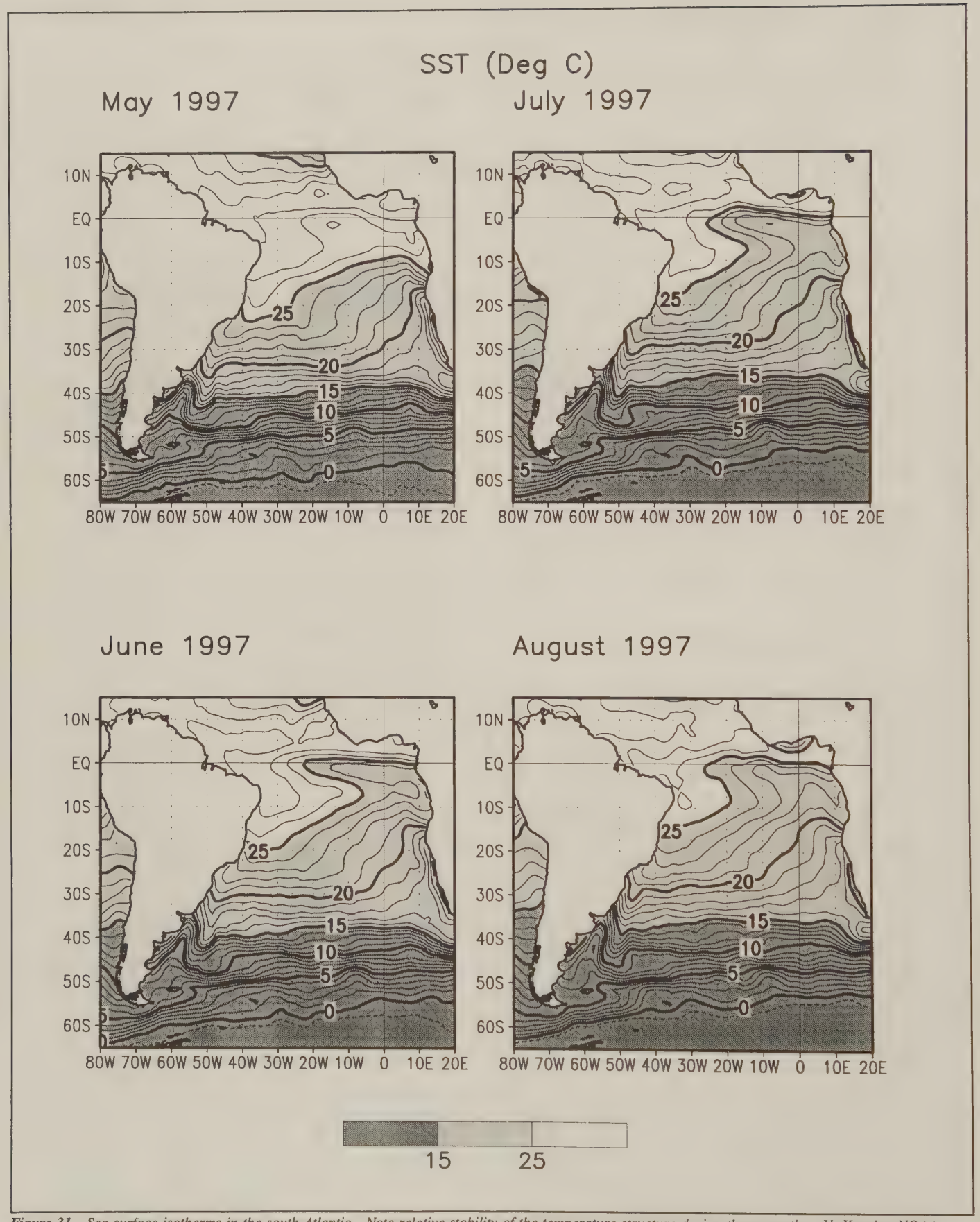


Figure 31.--Sea surface isotherms in the south Atlantic. Note relative stability of the temperature structure during these months. V. Kousky, NOAA

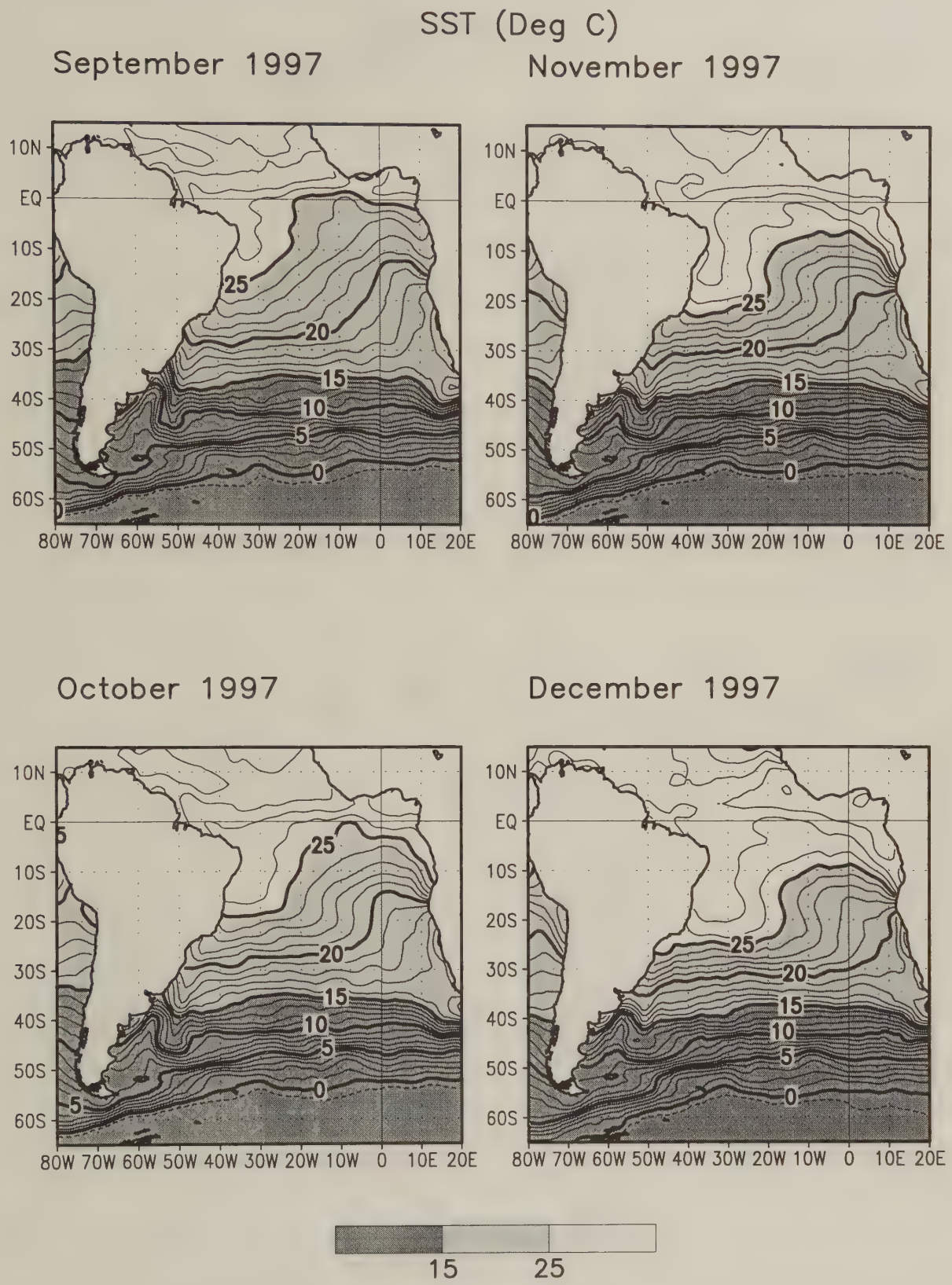


Figure 32.--Sea surface isotherms in the south Atlantic, note expansion northward of cold water, especially beginning in July. Vernon Kousky, NOAA

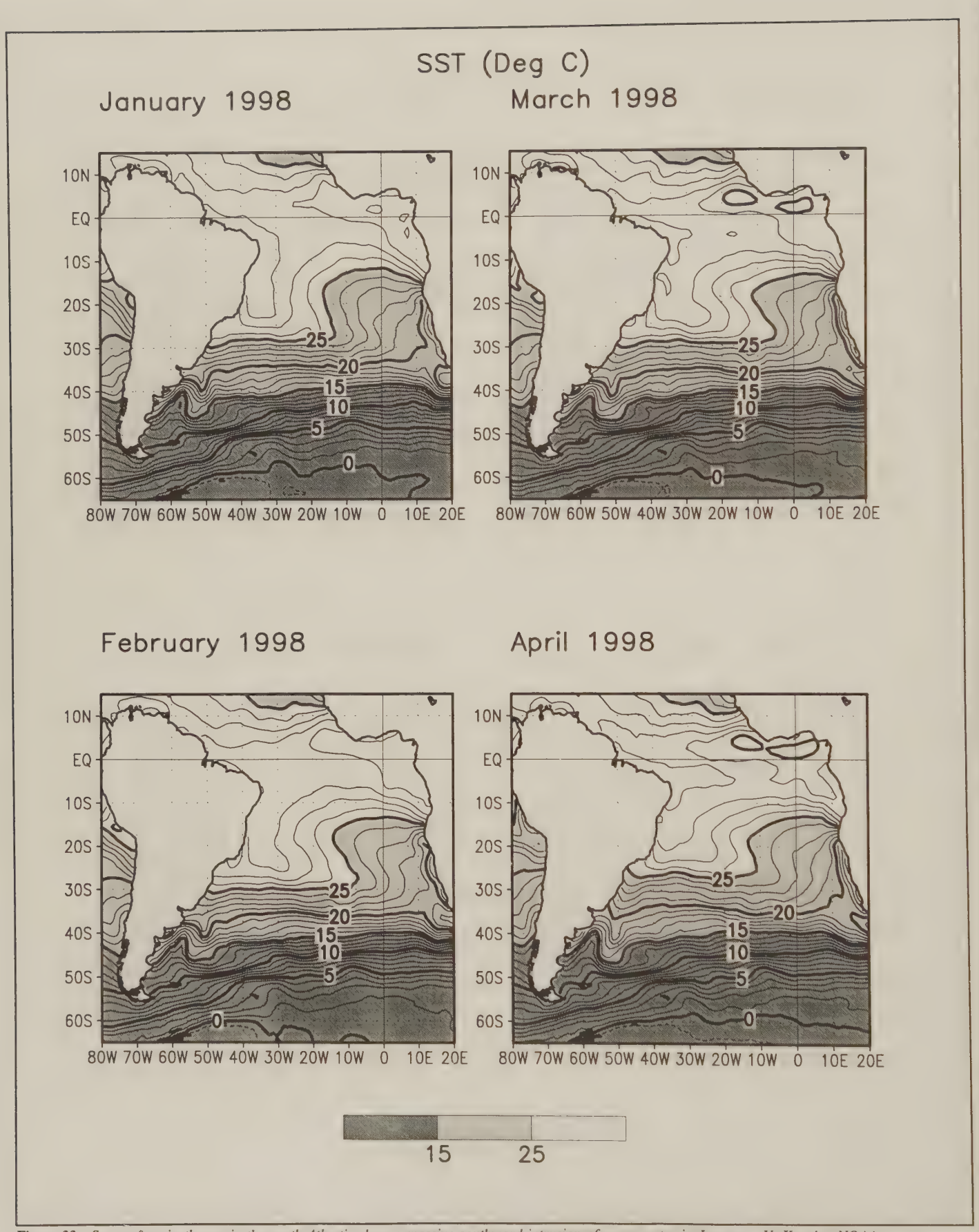


Figure 33.--Sea surface isotherms in the south Atlantic show a massive southward intrusion of warm water in January. V. Kousky, NOAA

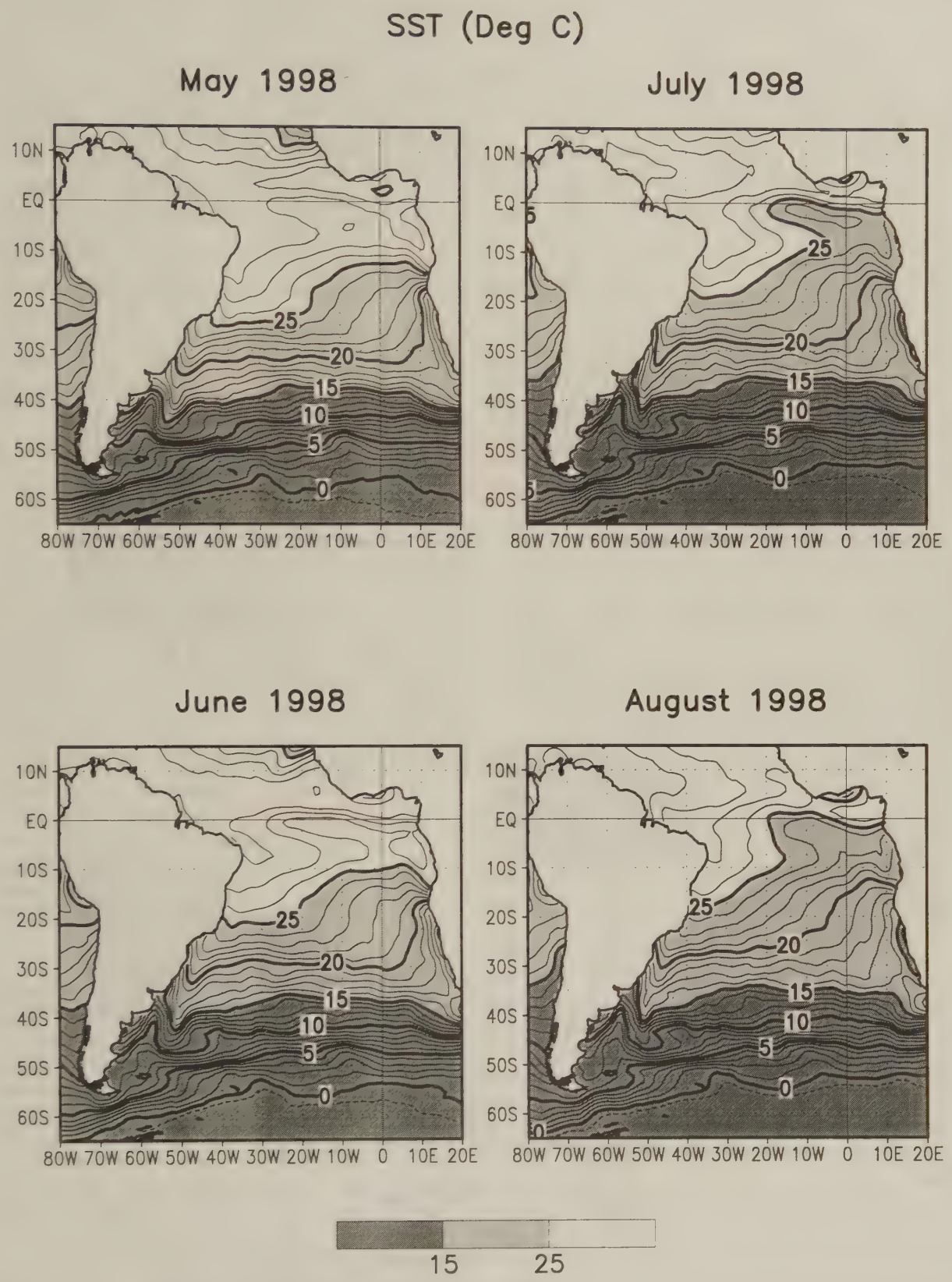


Figure 34.--Sea surface isotherms off Brazil were very stable during May-August 1998, with the colder water only moving slightly north. V. Kousky, NOAA

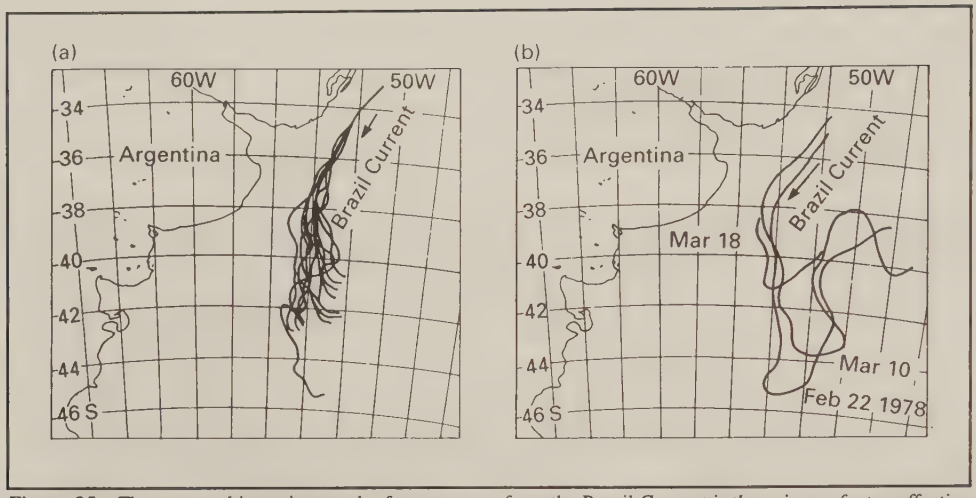


Figure 35.--The seasonal intrusion south of warm water from the Brazil Current is the primary factor affecting the seasonality of the swordfish fishery off southern Brazil and Uruguay. Legeckis and Gordon

fronts created by the Current, sometimes within a matter of only a few weeks.[147]

d. Malvinas/Falklands Current

The Malvinas or Falklands Current is a jet-like northward looping extension of the Circumpolar Current (figure 29 and Uruguay, photo 11). The jet-like extension of the Malvinas Current north is often referred to as a tongue and is the far northern extension. The separation point from the Circumpolar Current is strongest during Summer rather than the Winter months.[148] The Malvinas Current is most pronounced from fall to early spring (May to October).[149] (See: "Species: Seasonality.") The Malvinas current temperatures can be 12°C at the surface and 8-9°C at 80-100 meters.[150] The impact of the Malvinas current can be felt as far north as 20°S.[151] The Malvinas Current is discussed in greater detail in the Uruguayan chapter of this report. The Malvinas Current intrudes between the coast and the south Brazil Current carrying north rich Antarctic water as well as the freshwater outflow from the La Plata estuary.[152]

d. Upwelling

Upwelling occurs along the Brazilian coast, especially the central coast south of Cabo Frio. While less pronounced than along the western coast of Africa, the upwelling is of considerable importance. The southerly flowing south Brazil Current and a combination of factors (moving mass of deep water, southwesterly winds, and the coriolis effect) sets up vertical upwelling currents moving the nutrient-rich bottom waters to the surface. This occurs parallel and inshore from the south Brazil Current. An isothermic cross section of the Brazilian coast off Santos for a distance of 500 km shows a characteristic view of the ocean temperature isobars (figure 36). Further east the cold upwelled water sporadically bursts to the surface.[153]

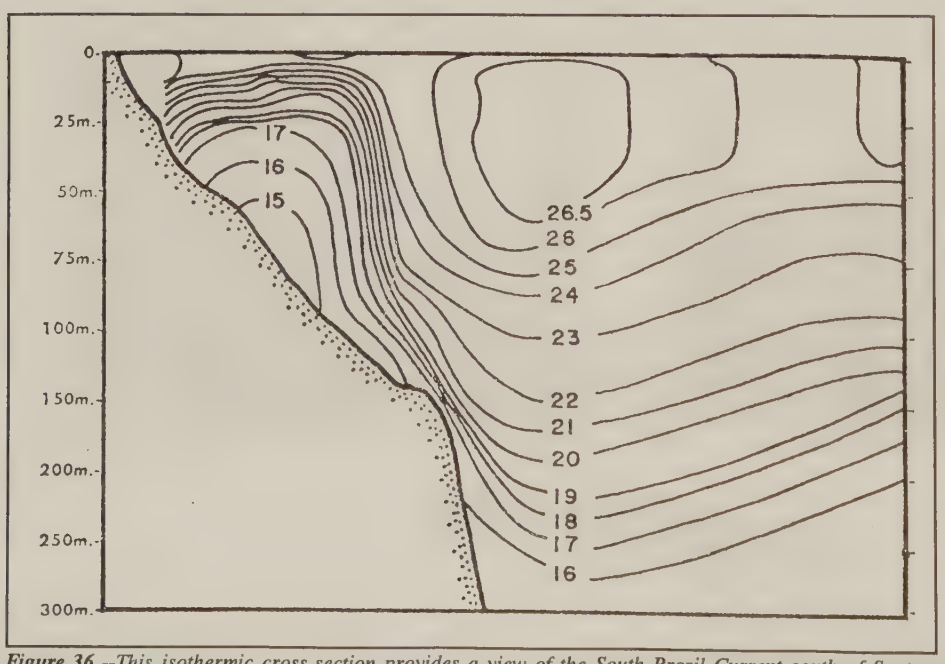


Figure 36.--This isothermic cross-section provides a view of the South Brazil Current south of Santos. Further east the cold upwelled water bursts through to the surface. Miles

The Brazilian upwelling zone stretches from southern Bahia to as far south as Santos. The effect is the strongest in the area off Cabo Frio near Rio de Janeiro. Here the cold water may sporadically reach the surface introducing green-colored water. This upwelling is called by the fishermen "agua fina" because of its importance in supporting coastal

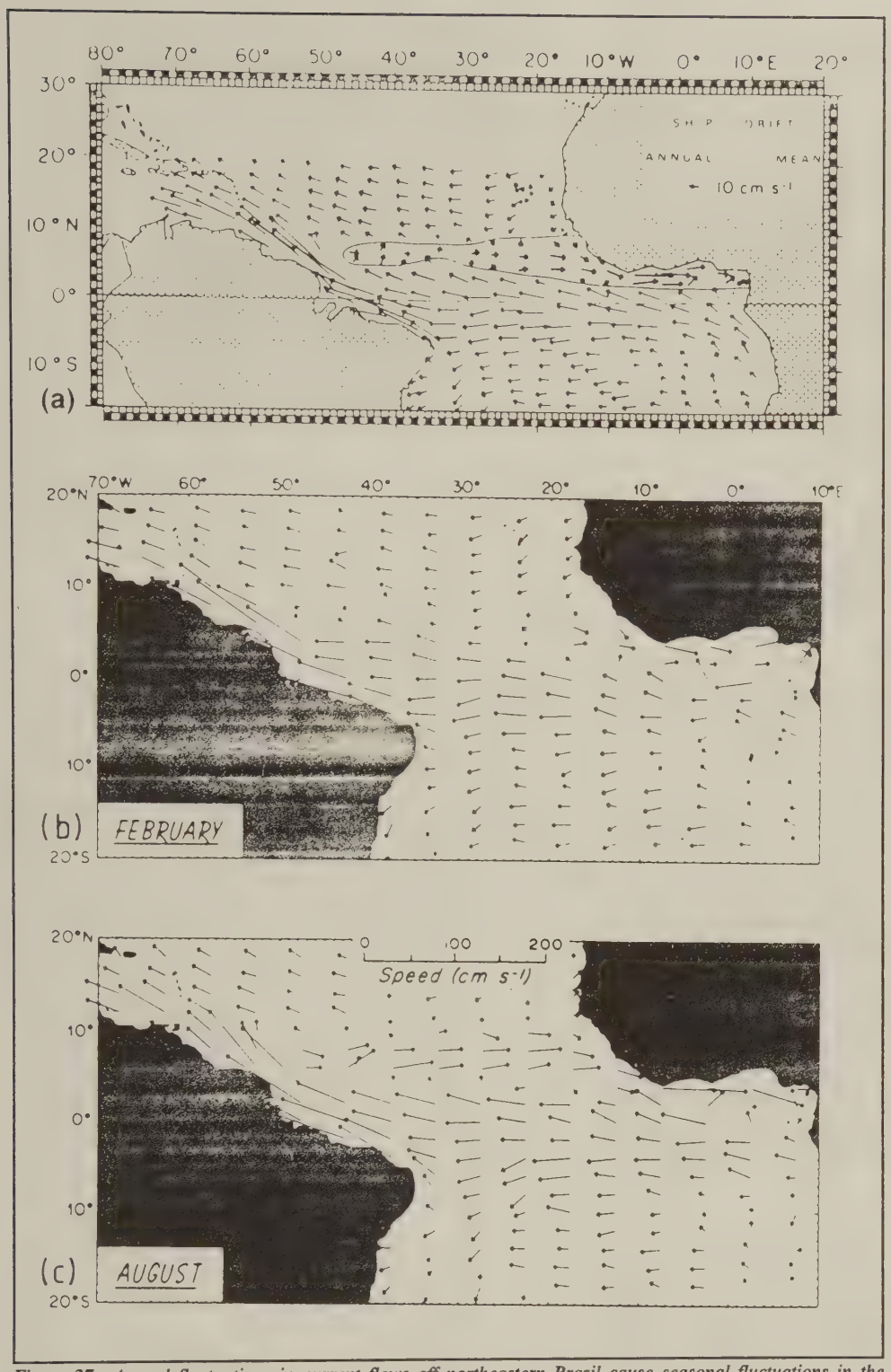


Figure 37.--Annual fluctuations in current flows off northeastern Brazil cause seasonal fluctuations in the swordfish fishery, even at tropical latitudes. Arnault, Richardson, Walsh, Tomczak, and Godfrey

stocks.

Brazil's coastal upwelling sustains an important population of sardines (*Sardinella aurita*) which is Brazil's most abundant stock and supports the country's largest single fishery. The population and, as a result, the fishery is highly variable and there have been notable recruitment failures.[154] The sardines serve as a fodder stock for predator species, especially off the central coast.[155] The swordfish prey on many species which feed on sardines. Upwelling is also important because the intrusion of colder bottom water into the upper levels of the water column may affect swordfish behavior and distribution. The authors know of no study assessing the impact of coastal upwelling on swordfish.

e. Subsurface currents

Biologists are giving increasing attention to the impact of subsurface currents on swordfish behavior. The relation appears to be significant, but poorly understood. Studying swordfish is difficult and assessing its behavior in reaction to constantly changing, difficult to follow subsurface currents at this point is virtually impossible. Some imaginative researchers are addressing the problem. Some work exists on the importance of subsurface currents and spawning.[156] (See "Species".) The authors know of no study assessing the relationship between subsurface currents and swordfish off Brazil.

2. Seasonality

The seasonality of the Brazilian swordfish fishery is related primarily to water temperature and current flow. The pattern is quite different in the northern and southern fisheries off Brazil.

Northern fishery: The moderate temperature fluctuations in the northern fishery mean that the fishery can be conducted year-round. There are fluctuations, however, primarily related to the seasonal changes in the current structure (figure 30).

Southern fishery: The Brazil Current separates from the shelf at 33-38°S, where it forms an intense front with the cold northern flowing Malvinas Current. The strength of the currents are highly seasonal and thus the location and strength of the frontal conditions is constantly changing (figure 30). This confluence of the Brazil and Malvinas Currents creates swirling temperature fronts and eddies and contributes to coastal upwelling. The resulting high productivity supports large populations of potential fodder species. Their swirling eddies are similar to those found along the Gulf stream along the US eastern seaboard, causing it to be one of the main focuses of U.S. fishermen.

3. Assessment

The oceanographic regime created by the confluence of the two currents off southern Brazil attracts oceanic predators to feed on squid and other fodder species.[157] The success of the fishery in this area appears to be due to these oceanographic conditions, especially the temperature fronts associated with the sub-tropical convergence.[158] The seasonal shifting strengths of the currents causes the seasonality of swordfish and tuna catches off southern Brazil. The fronts contribute to the enrichment of primary productivity and the presence of important populations of fodder species (especially *Illex* squid) which, based on analysis of stomach contents, dominate the diets of the large pelagic predators.[159] This is consistent with the findings of oceanographers in other areas which have noted that oceanic thermal fronts tend to concentrate prey, and as a result predator species. Commercial fishermen, take advantage of this phenomenon to determine where to set their nets and lines. Researchers report that the swordfish target one species of squid (*Illex argentinus*) close to the coast along the continental slope, but move further off the coast to target other squids (*Ommastrephes bartrami* and *Thysanoteuthis rhombus*).[160]

B. Topography

Brazil is the largest country in South America. The country's land mass covers about half the continent. Its coast of 7,400 km is the longest of the South American countries. Although it does not have the extensive shelf areas (depths above the 200 m isobath) like Argentina to the south, the Brazilian Atlantic shelf, except off the northeast coast, is much wider than the extremely narrow shelfs found along the Pacific coast of South America--especially off Chile and Peru.

The Brazilian shelf varies substantially along the country's extensive coast.

North: In the north from the French Guiana border (4°N) to the coast north of Fortaleza (4°S) the shelf is relatively wide. Shelf areas off the Amazon, for example, extend as far as 300 km off the coast.

Northeast: The shelf off the northeast coast is much narrower, especially south of Natal, an important port for the longliners targeting swordfish. The shelf narrows to only 15-20 km in some areas.

South: The southern coast beginning at about 17°S broadens somewhat. Brazil has several islands which extend its jurisdiction as far as 29°W into the Atlantic.

The Brazilian offshore islands are not as clearly connected with ocean ridges as are the Chilean Pacific islands. Two rocky outcroppings, St. Peter and St. Paul Rocks (1°N, 29°W), are located in the northern hemisphere in the middle of the Intertropical Convergence Zone. Two other island groups extend out from the northeastern coast: Atol das Rocas (4°S, 34°W) and Fernando de Noronha (4°S, 32°W).

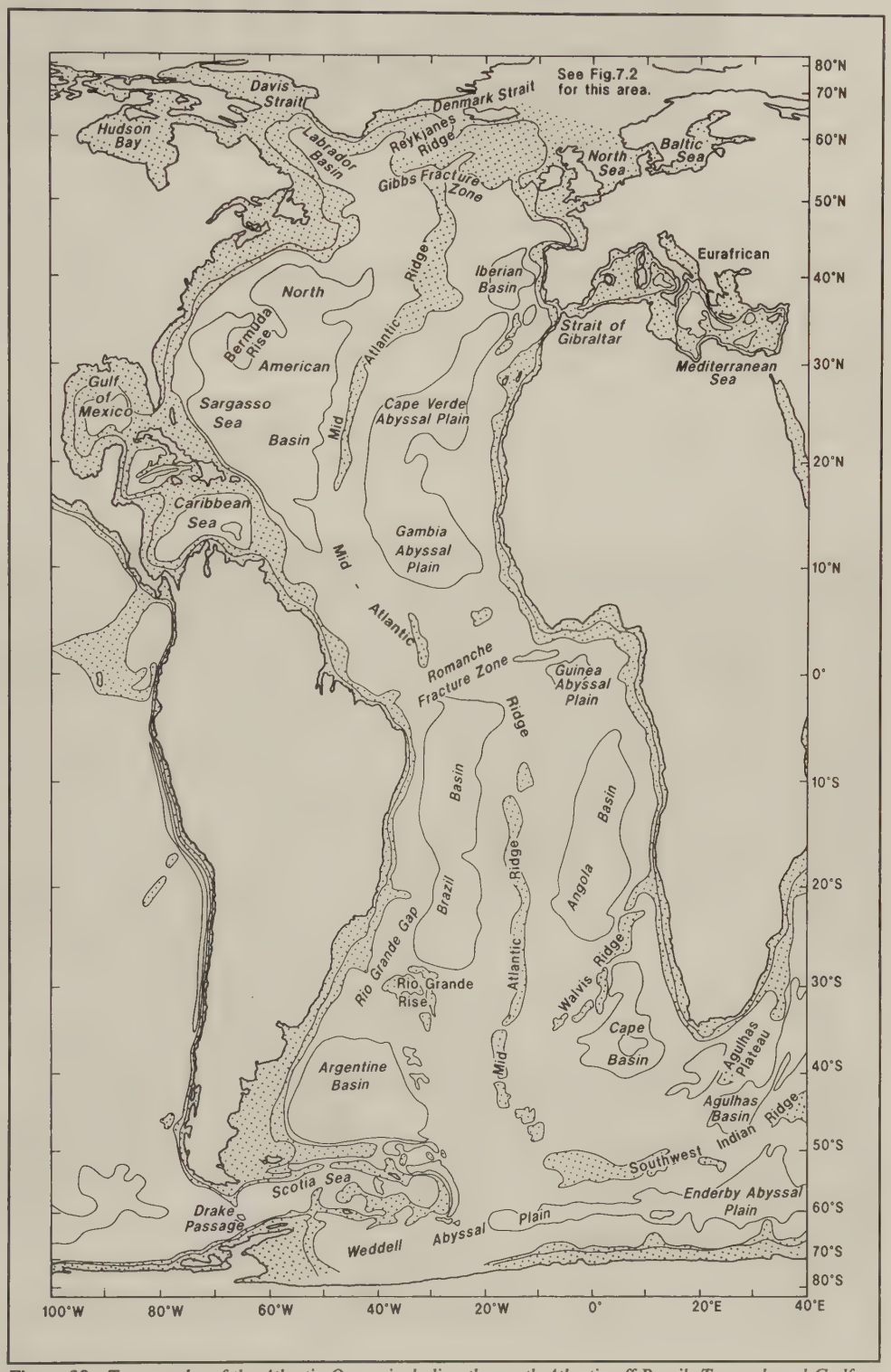


Figure 38.--Topography of the Atlantic Ocean including the south Atlantic off Brazil. Tomczak and Godfrey

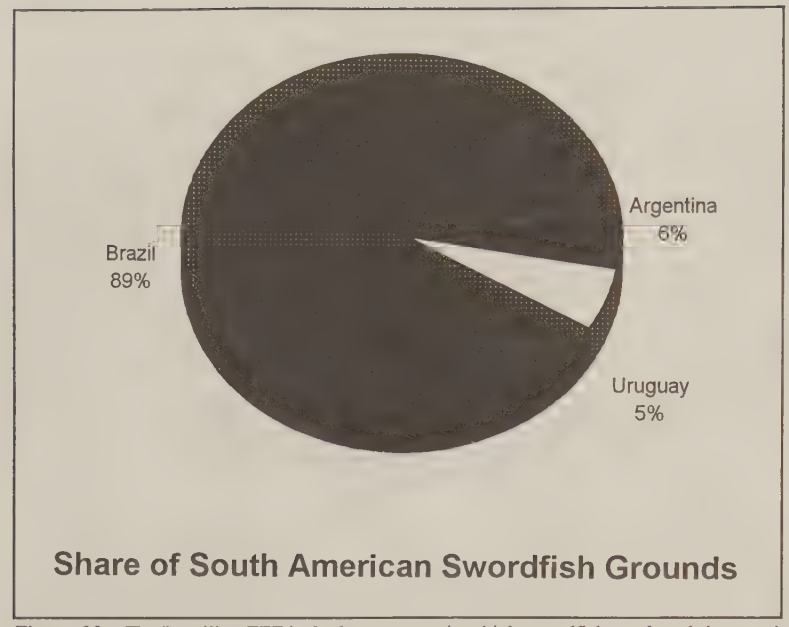


Figure 39.--The Brazilian EEZ is the largest area in which swordfish are found, but catch rates along much of the northern coast are not as high as along the southern coast and off Uruguay.

Further south, a little north of Rio de Janeiro, an area of relatively shallow water extends out from the southern coast connecting the Vitória Seamount, Ilha Martin Vaz (20°S, 29°W), and Trinidae (21°S, 29°W).

One important feature is the Brazil Basin, which extends roughly from 2°-25°S and 20-30°W (figure 38). It covers a very substantial area of the offshore grounds targeted by the Brazilian and foreign fleets operating in the southwest Atlantic. This is a vast area of extremely deep water. Depths in the basin exceed 3,000 meters. Much of the Brazilian catch along the southern and southeastern longline fleet is taken east of the deep waters of the Brazil Basin. The shelf off the northeast coast, however, falls off directly into the Brazil Basin and it covers a much larger area of the northeastern fishing grounds than is the case of the fishery conducted in the south and southeast. The location of the Brazil Basin means that substantial quantities of swordfish are being taken in areas where the fish may at times move into very deep water.

Photo 15.--Brazilian captains have learned from the former Japanese captains many of oceanographic indicators helpful in deciding where to set their lines. D. Weidner.

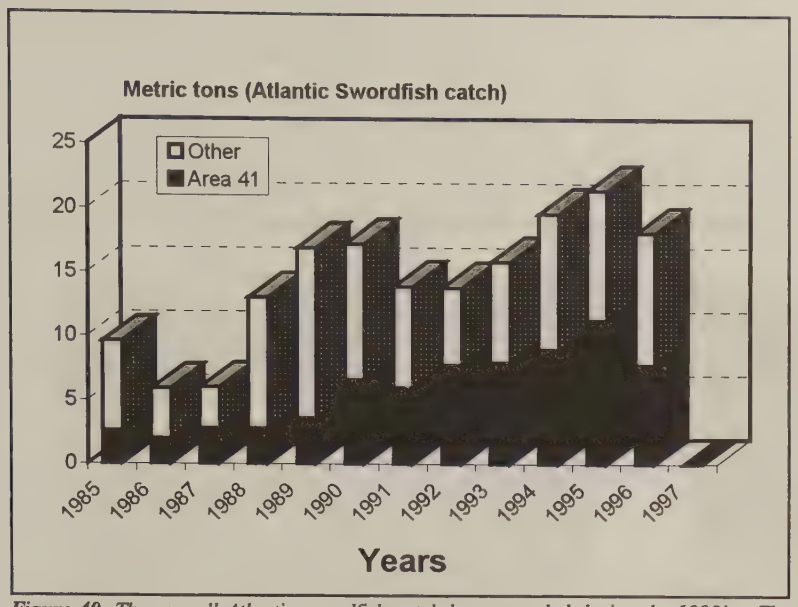


Figure 40--The overall Atlantic swordfish catch has expanded during the 1990's. The southwestern Atlantic (FAO area 41) off South America was the primary area in 1995, but this has varied annually.

Bottom topography can be important in locating swordfish. Swordfish sometimes inhabit submarine canyons and other specific features. This appears to vary significantly depending on the size and age of the fish. Swordfish behavior is not well studied. Some interesting work has been done on adult swordfish abundance near shelf break canyons in the Atlantic Ocean.[161] As the data for the study was logbook data, it did not cover juveniles.[162] The authors, however, know of no such work specifically off Brazil.

C. Fishing areas

South Atlantic swordfish landings have expanded significantly since the late 1980s. The fishery is conducted in two areas with very different characteristics, one tropical and the other temperate.

Tropical: The tropical south Atlantic fishery is primarily conducted off Africa in the Gulf of Guinea and into the mid-Atlantic at latitudes of from 5°N-10°S.

Temperate: The temperate south Atlantic swordfish fishery has primarily been conducted off southern Brazil and Uruguay (25°-40°S). Most of the catch is taken in relatively coastal waters, but some fishing also occurs in the mid-Atlantic.[163]

Brazilian and foreign fishermen take swordfish throughout the year in directed fisheries and as an incidental catch of the tuna longline fishery all along the Brazilian coast.[164] The species occurs in both tropical and temperate waters. There are, however, areas of greater abundance which are targeted by the fishermen. Fishing operations are reported from 10°30'N along the border with French Guiana to 42°50'S in international waters off Argentina. Most of the Brazilian catch has traditionally been taken in the southern fishery, especially in the area from about 20-30°S, although some observers describe a wider range of 15-35°S.

1. Brazilian fleet

The Brazilian longline fleet conducts operations off both the southern and northern coast, although the southern fishery is much more important.

Southern coast: The southern fleet is based primarily in Santos, although increasing costs in the late 1990s are driving fishermen to other parts. The fleet generally operates on grounds roughly between 20/23°-30/31°S and 30°-50°W. The most heavily targeted grounds have been primarily along the country's southern coast from Cabo Frío (23°S) to Tramandaí (31°S) along Brazil's southern border with Uruguay.[165] Some observers describe a wider range of 15°-35°S and 25°-50°W,[166] perhaps including some areas with lower catch rates. The division point between the southern and northern fisheries is somewhat unclear. Some Brazilian officials use 25°S as the dividing point.[167] The bulk of the swordfish catch and the highest CPUEs are reported in the southern fishery. Operations from Santos dominate the Brazilian fishery (appendix E3b1d) although this may be changing in the late 1990s. The focus of fishing effort appears to shift somewhat to the south during the southern winter.[168]

Northern coast: The Brazilian vessels based in the northeastern states tend to operate between 5N/0°-15/20°S and 25°-40°W.[169] The northern longline operations are usually conducted primarily in near-shore waters. Brazilian fishermen have been expanding operations off the northeast coast in recent years, especially after October when catch rates decline in the traditional southern and southeastern grounds.[170] Brazilian fishermen reported substantially increased catches in the northern fishery during 1997 and 1998.

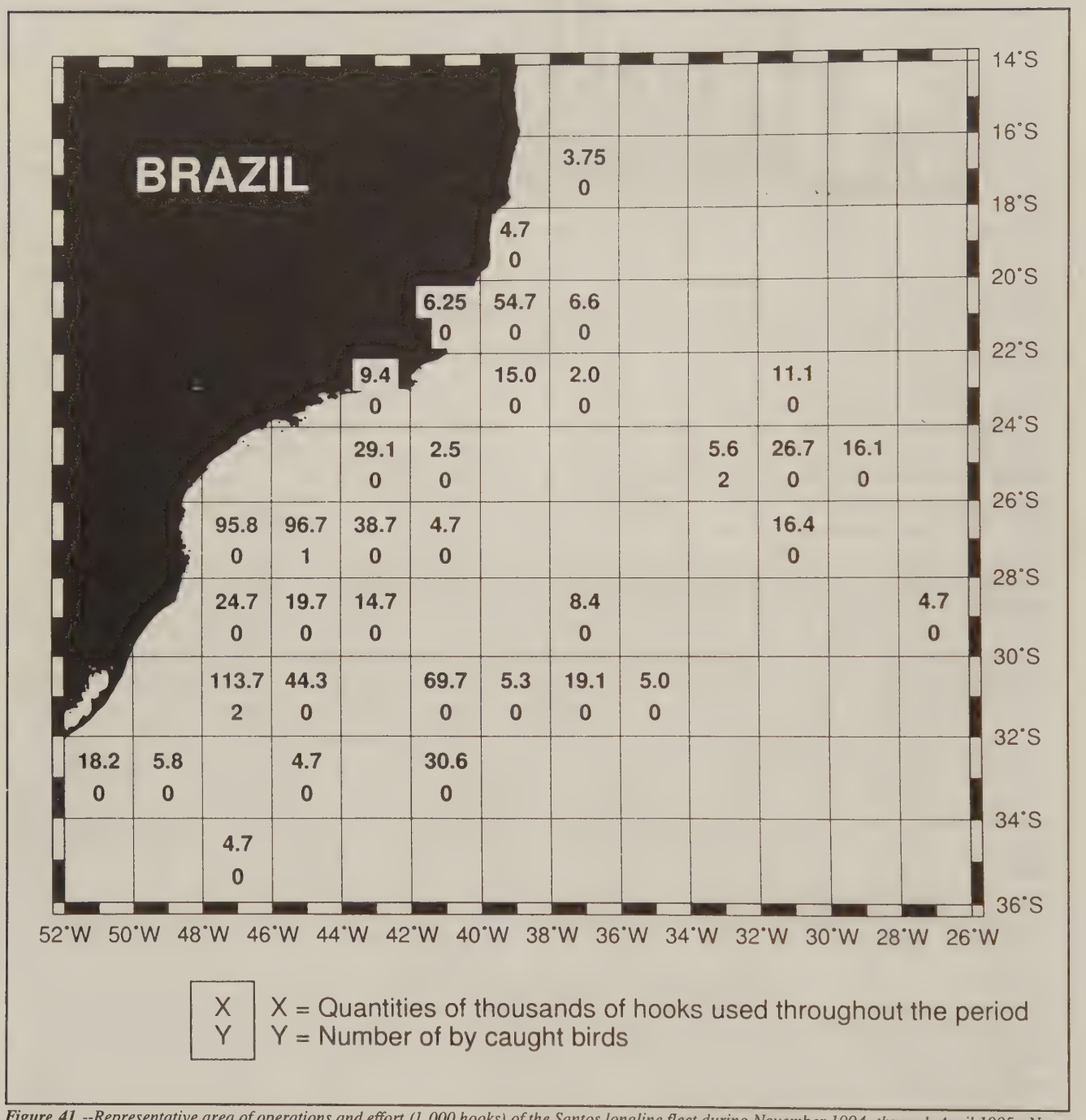


Figure 41.--Representative area of operations and effort (1,000 hooks) of the Santos longline fleet during November 1994, through April 1995. Neves and Olmos

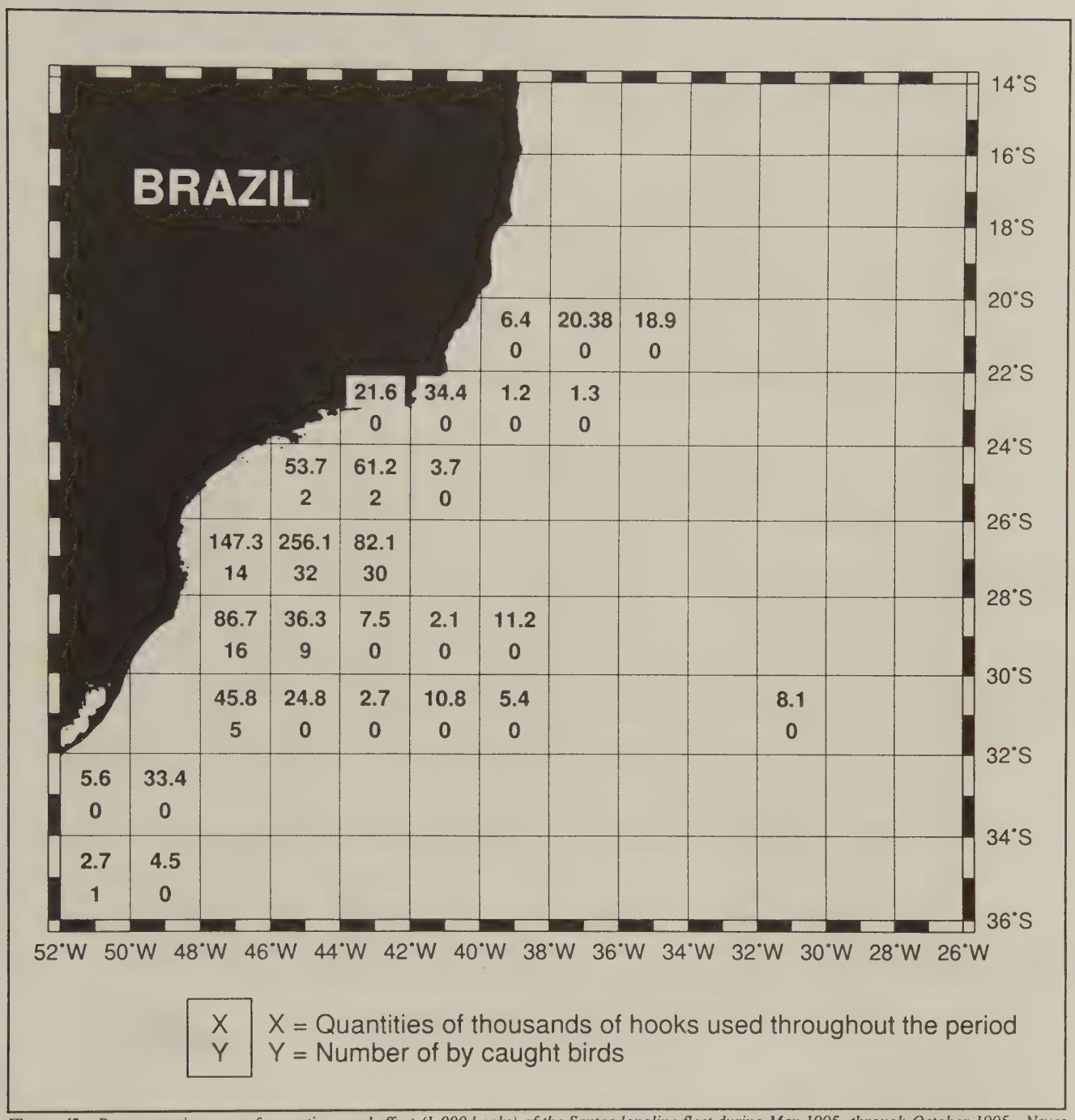


Figure 42.--Representative area of operations and effort (1,000 hooks) of the Santos longline fleet during May 1995, through October 1995. Neves and Olmos

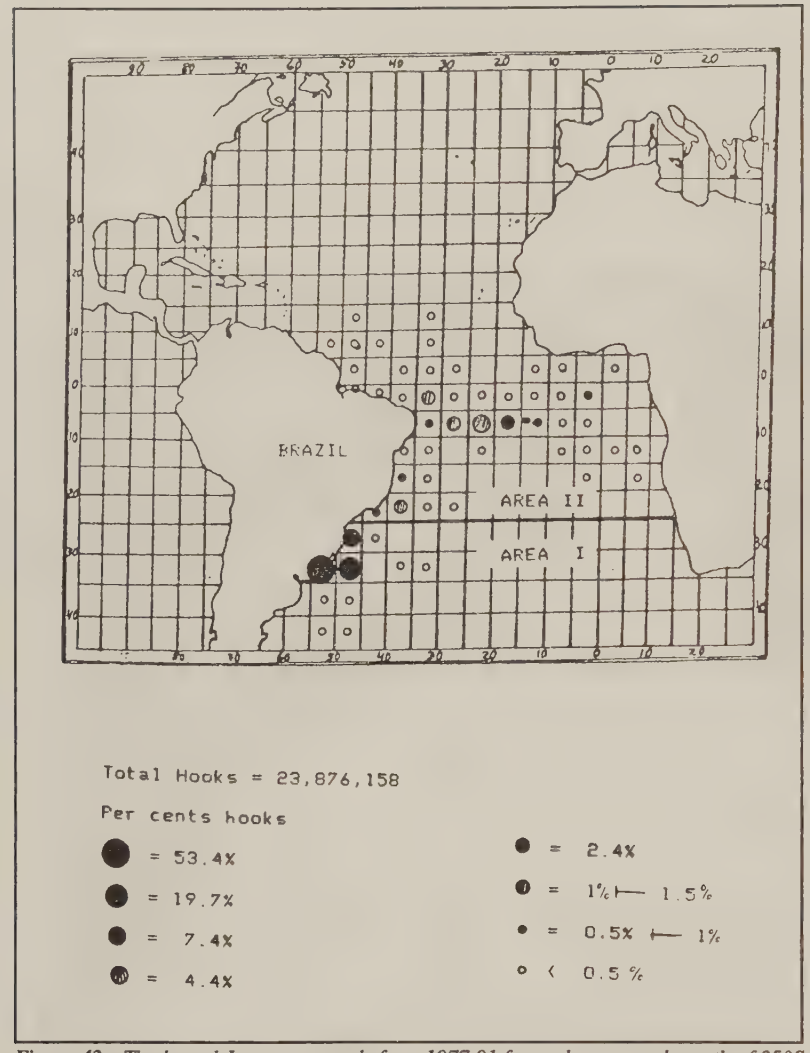


Figure 43.--The leased Japanese vessels from 1977-91 focused on grounds south of 25°S (area I), primarily off Brazil and Uruguay. ICCAT CVSP, 1994

2. Leased fleet

a. Japan

The Japanese longliners leased by the Leal Santos company in Rio Grande (RGS) during the late 1970s and 1980s have primarily fished well south of the equator, usually from 20°-34°S, area II (figures 43 and 44). One 1986 report indicated that the Japanese vessels were deployed in tropical waters near Ascension Island where bigeye are common during the first quarter of the year and then to the south off southern Brazil (28°-34°S) for the remainder of the year.[171] The Japanese vessels have also been deployed from northern ports. They have been deployed as far north as 15°N and as far east as the western coast of Africa (10°W) between 5°N-20°S. Operations have been extensively conducted in the south mid-Atlantic, especially between 0°-10°S. Operations are conducted all along the Brazilian coast from northern Brazil (5°N) to southern Brazil, Uruguay, and northern Argentina (40°S).

Southern operations: The Japanese leased vessels have primarily fished on the southern grounds. Historical data reveals that about 80 percent of the Japanese fishing effort has been on the southern grounds (south of 25°S) (appendix D1b). Most of the fishing south of 25°S is relatively close to the coast, west of 45°W. Over half of the Japanese effort is conducted even closer to the coast (west of 50°W) and up to the Uruguayan border (34°44'S) and west of 50°W. Over 70 percent of the Japanese effort was reported in the extreme southern area (south of 30°S) of the coast, close to the Uruguayan border.[172] This explains the former importance of the far southern port of Rio Grande. (See: "Ports.") Fishing on these grounds is not directed exclusively at swordfish. It is a multiple species fishery and tunas are usually the major target species. Operations are seasonal. The Japanese conducted southern operations during the colder months (April to October) off southern Brazil and shifted to the north during the warmer months.[173] Yields are reportedly even higher off Uruguay, but the reported Japanese effort is presumably in Brazilian waters because since 1969 when Uruguay

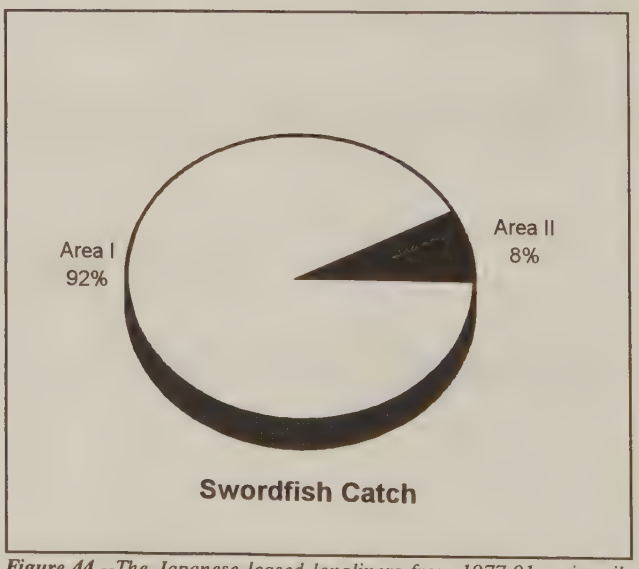


Figure 44.--The Japanese leased longliners from 1977-91, primarily operated south of 25°S (area I). ICCAT CVSP, 1994

Photo 16.--Taiwan longline fishermen operate extensively in the south Atlantic, off both Brazil and Uruguay. D. Weidner.

claimed a 200-mile zone, the Japanese have not had access to Uruguayan waters. A recent Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis (IBAMA) report on operations of leased vessels indicates extensive coastal fishing from about 15°-35°S and offshore fishing between 15°-30°S that extends at 15°-20°S latitude almost to 10°E (figure 45).[174] One report from Uruguay suggests that Spanish longliners often focus on the Vitoria-Trindade Seamount when operating off southern Brazil outside the EEZ.[175] Since expanding operations in the western south Atlantic in the 1990s, this appears to be an area that they are fishing heavily. This may also be the case for the Japanese.

Northern operations: The Japanese, since initiating operations in 1977, have conducted seasonal operations off northeastern Brazil. At first fleet movements were irregular, but beginning in 1985 they began to regularize their operations. The Japanese generally fished during the fall and winter (April-October) in the south. Then during the spring and summer (November-March) they tended to reduce operations off southern Brazil and shift to equatorial waters off northeastern Brazil, Ascension Island, and along the coast of West Africa.[176]

Other operations: The Japanese leased fleet reported minimal operations outside of the northern and southern grounds of the southwest Atlantic. Only 1.7 percent of the total Japanese longline fishing effort for all species was on grounds outside the southwest Atlantic. This would mean an extremely small part of the swordfish catch as swordfish is only about 10 percent of the total catch.[177]

b. Taiwan

Few details are available on the fishing grounds targeted by the Taiwan vessels that have been leased since 1991. One local observer reports that they operate all along the Brazilian coast.[178] During several years the Taiwan longliners operated from Rio Grande, suggesting they were targeting areas off Brazil's far southern coast, both inside and outside Brazil's EEZ. One report from Uruguay suggests that Spanish longliners often focus on the Vitoria-Trindade Sea mount when operating off southern Brazil outside the EEZ.[179] This may also be the case for the Taiwan longliners.

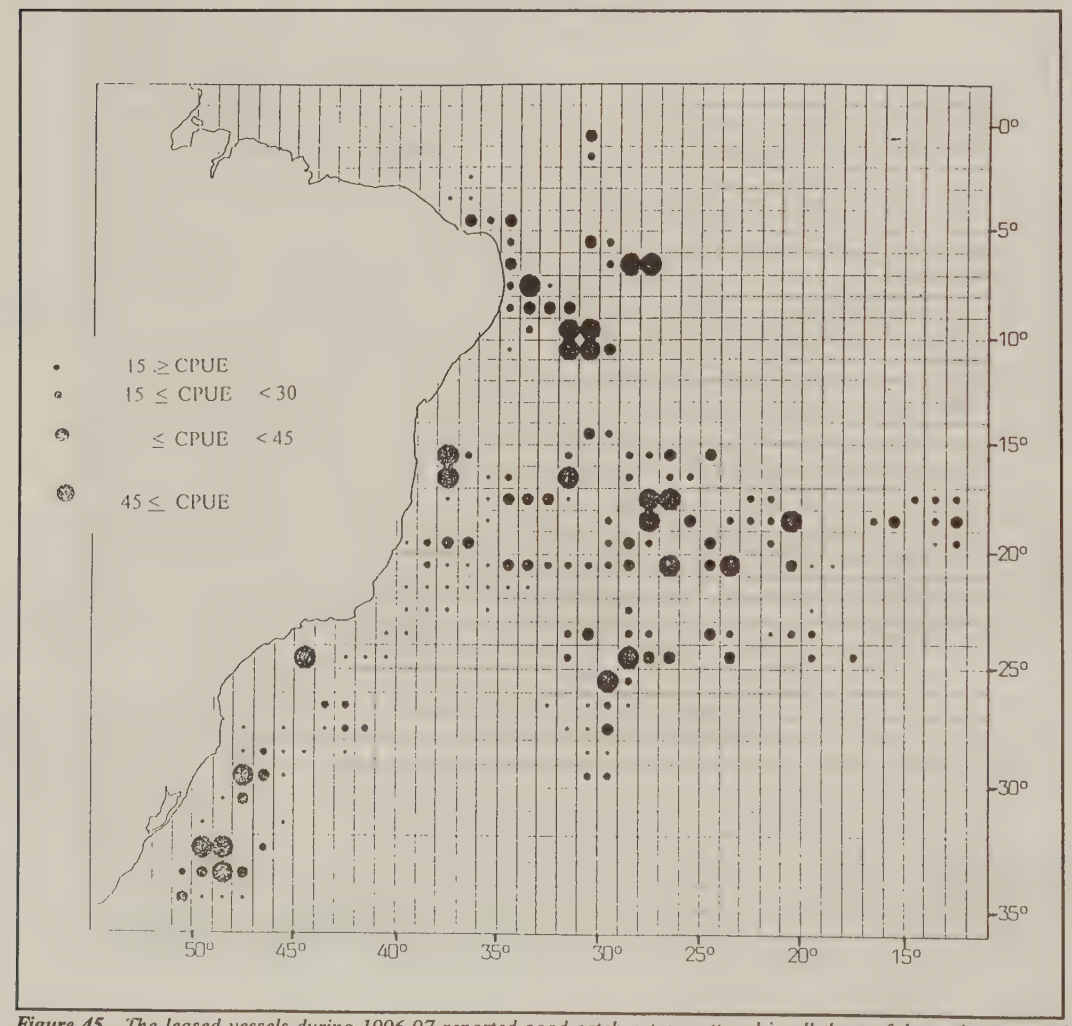


Figure 45.--The leased vessels during 1996-97 reported good catch rates scattered in all three of the major areas of operation off Brazil. Dias and Lima

c. Other countries

Brazilian companies have mostly leased longliners from Japan. The companies during the 1990s have, however, participated in leasing arrangements with a much more diverse group of foreign fishermen. The operation of several Taiwan longliners were arranged beginning in 1991. It is unclear to the authors if the initiative for this comes from the Brazilian companies or from the foreign fishermen, but it appears to come primarily from greater foreign interest.[180] This could reflect the efforts of foreign governments to reduce fishing effort on increasingly heavily fished stocks. Some of the other countries involved have included Korea (beginning in 1994), Panama (beginning in 1992), Portugal (beginning in 1992), and Honduras (beginning in 1990) (appendix A1c). The Panamanian and Honduran longliners were flag-of-convenience registrations for foreign owners. Press and various unconfirmed sources suggest that Spanish, Barbados,[181] and United States longliners have also been active. The numbers of vessels involved from these countries, however, have been relatively small. Even so they have resulted in major changes in the Brazilian fishery, especially in fishing methods. (See "Fleet Operations and Gear".) One major impact has been on the grounds fished. Some of these foreign longliners were equipped with freezers and could make longer trips and stay on the fishing grounds longer. As a result, they have begun fishing north of the traditional grounds where the domestic fleet has operated. This opened up a new fishery off the northeastern coast and altered the seasonality of the fishery. Fishing on the traditional southern and southeastern grounds is usually conducted from June to October. Many fishermen then shift operations to the northeast.[182] The foreign fishery of the northeast coast appears to have been one factor in the expansion of Brazilian fishing off the northeast in the late 1990s.

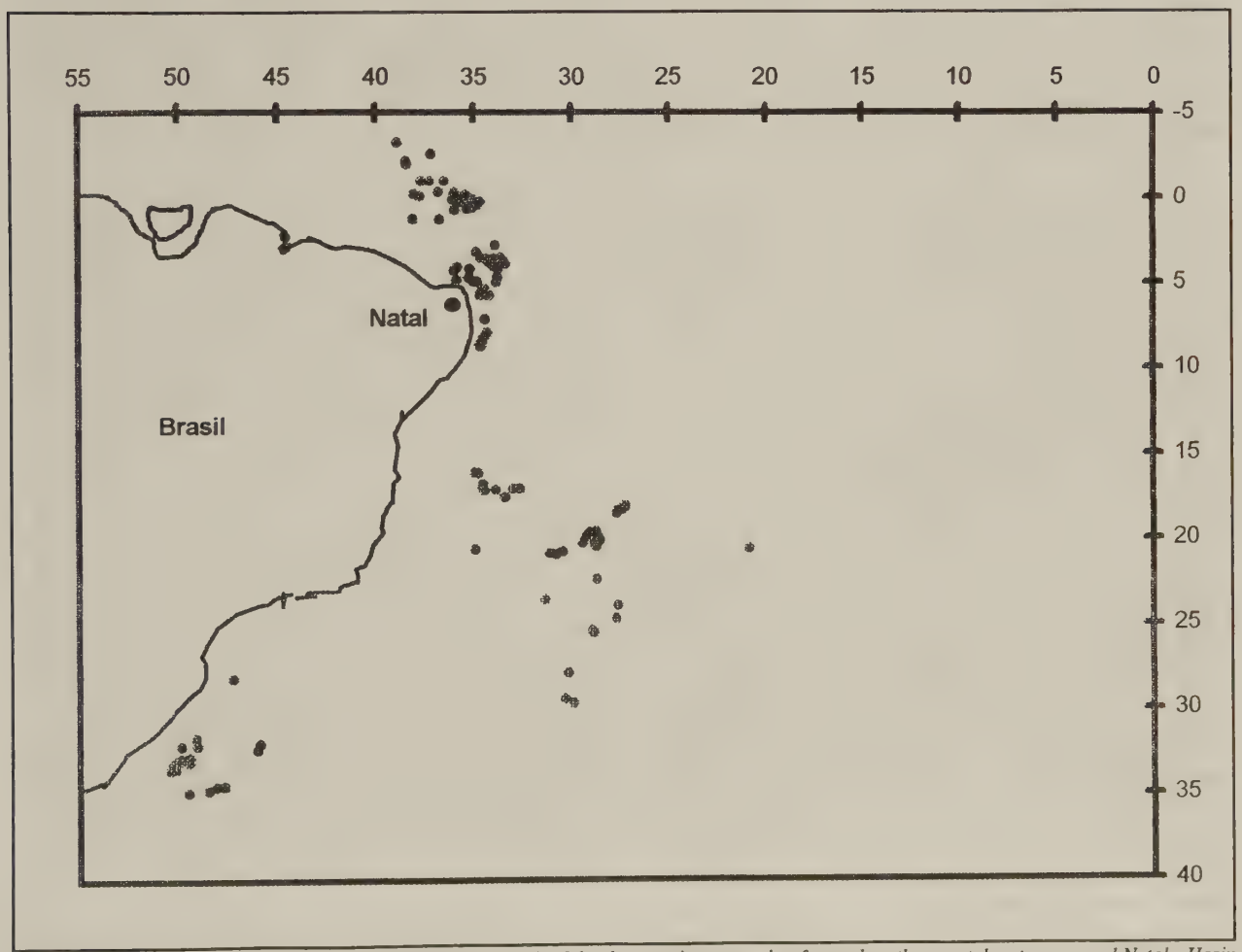


Figure 46.--Two leased vessels during 1996-98 fished in each of the three major areas, but focused on the coastal waters around Natal. Hazin and Hazin

Photo 17.--The longline fishery off the northeast coast, especially out of Natal, has become increasingly active in the late 1990s.

Leased vessels in recent years have operated in three major areas. Extensive effort has been deployed in all three areas, but the central grounds have accounted for about half of the overall effort committed to the fishery.

Northeast (5°N-12°S): Extensive fishing effort is often clustered around Natal, some quite close to the coast. Fishing in 1997-98 ranged from 0°-12°S out to about 30°W (figures 45 and 46). In some years operations may extend north of 0°. A study of two longliners during 1996-98 indicated operations to about 4°N, but much of their sets were in the immediate vicinity of Natal.

Central (15°-25°): Fishing along the central coast is conducted at a greater distance from the coast than the northern or southern fishery. Operations along the central coast extended as far east as 12°W (figures 41, 42, 45, and 46). This would be closer to the African coast than to the Brazilian coast. The highest yields, however, in this fishery appear to be at mid-oceanic longitudes, 20-32°W (figures 45).

South (25°-35°S): The southern fishery is the most coastal, extending only 100-200 km from the coast, primarily to about 45°W. Catch rates in 1996-97 were best in the southern area of the southern zone (figure 45). Interestingly, while there was little or no fishing at southern latitudes from longitudes 39°-33°W in the Rio Grande Gap, fishing was again reported east of 33°W, north of 30°S. This is roughly northeast of the Rio Grande Rise (figure 38). This fishing at 28-33°W, however, is associated with the much more extensive operations of vessels in the central zone.[183]

***Photo 18**.--Brazil has the largest artisanal fishery in Latin America. Many fishermen for years operated with only sails and oars.*

IV. Fleet

The Brazilian swordfish catch is taken almost exclusively by the commercial longline fleet. Both domestic and foreign leased vessels are active in the fishery, and account for almost all of the catch. An increasing number of Spanish longliners in particular were active in the fishery during 1998. The small boats in Brazil's large artisanal fleet have not been employed in fisheries targeting large oceanic pelagics like swordfish. Even so, artisanal catches of tunas have been reported and in some years the catches have been appreciable. Researchers along the northeastern coast in 1997 have reported some success in adapting longline fishing to small boat artisanal fishing. Fishermen in boats as small as 12 m have begun taking swordfish and other oceanic pelagics. Brazil has a small recreational fleet, but it does not normally take swordfish.

A. Commercial

Brazilian companies deploy both baitboats and longliners to target tunas and other highly migratory species. Almost all of the swordfish catch is taken by the longline fleet.

1. Baitboats

The Brazilian baitboat fleet consisted of 21 domestic vessels and four vessels leased from foreign owners in 1993. Most of the Brazilian baitboats ranged from 51-200 GRT, although two were smaller. The baitboats leased from Japan all exceed 151 GRT. A Brazilian company acquired one large baitboat (over 151 GRT). This larger vessel was built in 1989 and equipped with a brine freezer system. The baitboat fleet is comparable to the large baitboats leased from Japan. The fleet in recent years has remained relatively stable at 21 vessels, although there has been a noticeable shift from ports in Rio Grande do Norte to Santos (appendix A1c).[184] The baitboat fleet targets tunas (mostly skipjack) and rarely takes swordfish.

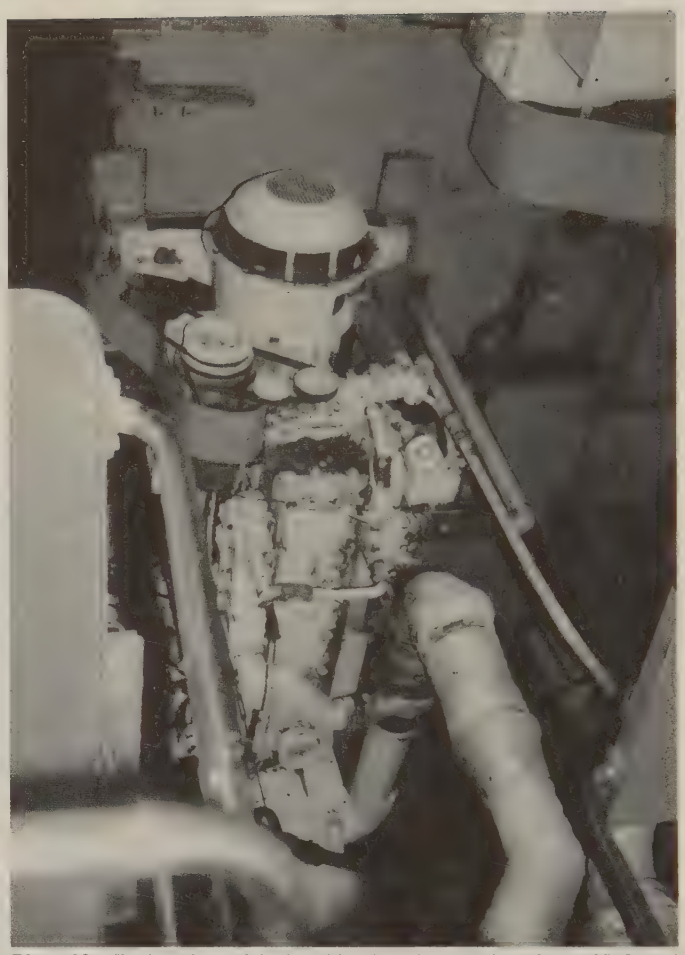


Photo 19.--Engine plant of the Brazilian longliner "Taime: Maru 3". Dennis Weidner.

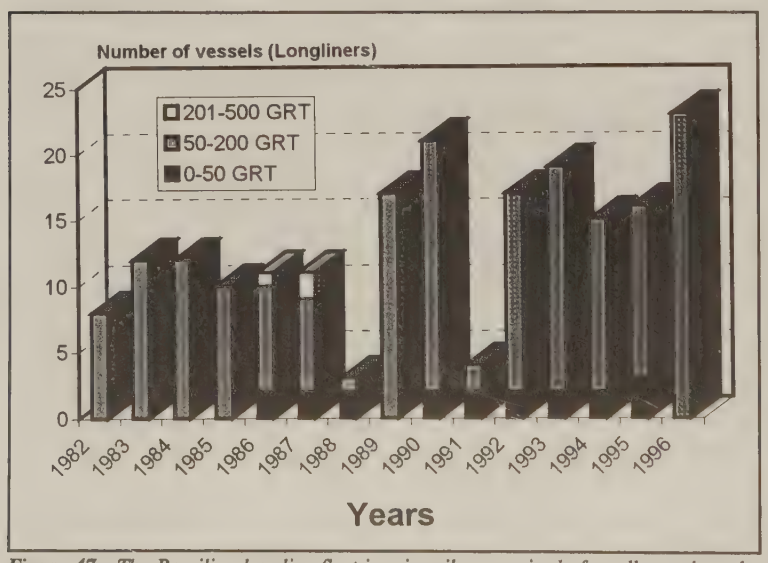


Figure 47.--The Brazilian longline fleet is primarily comprised of small vessels under 50 GRT. The number of vessels active in the 1990s has increased over the number during the 1980s.

2. Longliners

Both Brazilian and leased foreign vessels participate in the longline fishery for swordfish and tunas. Most of the fleet is composed of Brazilian vessels, but a varying number of larger, more modern, vessels have been leased from foreign countries (mostly Japan and Taiwan) (appendix A1c). The overall Brazilian

Photo 20.--Typical Japanese-built longliner used through the mid 1990s. These vessels were operating from Santos in 1996. D. Weidner

Photo 21.--These vessels operated by the Kawai company were abandoned in Santos after the company went bankrupt in 1997. D. Weidner

Photo 22.--The foreign longliner in the foreground deploys its line from an enclosed area at the stern (door is shut). The Brazilian longliner at the right has an open stern. D. Weidner.

Photo 23. One of the many "Tooshin Maru" vessels used by Brazilian companies during the 1980s and early 1990s with Japanese multi-species methods. Dennis Weidner

Photo 24.--Brazilian longline "Itapui" at the port of Santos in 1996. The "Itapui is one of the many Brazilian vessels built for other fisheries and re-rigged for longlining. D. Weidner

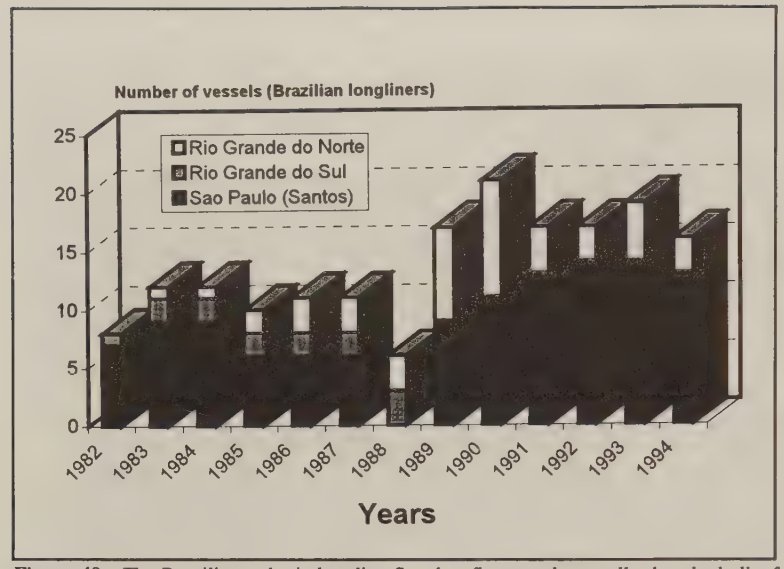


Figure 48.--The Brazilian pelagic longline fleet has fluctuated annually, but the bulk of the fleet is based in Santos.

longline fleet has increased significantly during the 1990s, primarily because of the expansion of the domestic fleet and the addition of a large number of leased vessels from Taiwan (appendix A1b8). The domestic fleet consisted of 21 longliners in 1990 and 19 longliners in 1993. Lower numbers were subsequently noted, but more recent reports from Brazil indicate new vessels were added in 1996-97, including some smaller vessels that have reportedly proven quite effective.[185] The leased fleet peaked at 36 longliners in 1993, but reports from Brazil also indicate some additional foreign vessels were participating in the fishery during 1996-97. The government appears to have decided to terminate the leisure program in 1999.

a. Brazilian fleet

Brazil has a small domestic fleet of longliners. ICCAT data show that fleet operations were conducted by 10-12 longliners during most of the 1980s. Suddenly in 1989 the fleet expanded to 17 longliners and through 1996 varied from 16-23 vessels (appendix A1a). The authors do not have detailed data on fleet fluctuations and cannot explain the annual fluctuations. ICCAT data shows two anomalous years (1988 and 1991) when only 3-4 vessels were active. The authors believe that this may be inaccurate data provided by the Brazilian Government and that it is unlikely the fleet actually declined to such low levels. Many of the vessels are refitted vessels from the lobster or other fisheries.[186] Several are imported vessels including several Japanese vessels. The Brazilian longliners are relatively small vessels varying from 51-200 GRT (appendix A1a). The vessels are mostly in the 100-200- GRT range.[187] A few smaller longliners have also been deployed. Most of the vessels have steel hulls, but several of the smaller vessels have wood hulls. The vessels are "fresqueros" and are not equipped with freezers. One observer notes that in 1996 the Brazilian fleet mostly operated out of Santos and the vessels there averaged about 25-30 m in length.[188] Vessels as small as 16 m have operated in the fishery.[189] The domestic fleet has fluctuated from 5 longliners (1980-81) to 21 longliners (1990). The fleet declined to 16 longliners (1994-95) but increased sharply to 23 longliners in 1996 (appendix A1a). Unconfirmed reports suggest that a few additional vessels, including some smaller vessels, were added to the fleet in 1997.

1980-82: The Brazilian longline fleet totaled 5 vessels during 1980-81, but increased to 7 in 1982. Most of the fleet was based in Santos (appendix A2a1). The first domestic longliner was reported at Rio Grande (RGS).[190]

1983-88: The Brazilian fleet increased significantly to 12 vessels in 1983 and remained at that level in 1984. The fleet fluctuated little from 1985-87, varying from 10-11 vessels. Information is not available for 1988. Most of the fleet was based in Santos, but two additional vessels were added to the small Rio Grande do Sul and Rio Grande do Norte fleets.

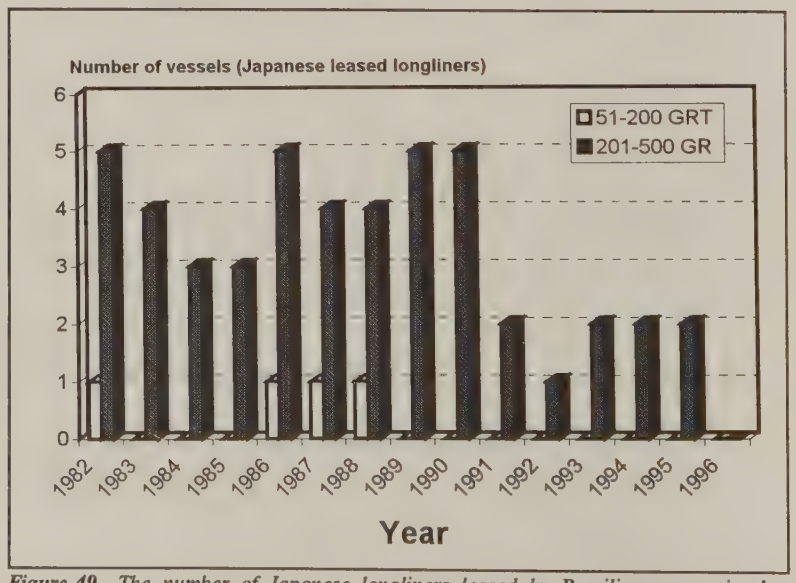


Figure 49.--The number of Japanese longliners leased by Brazilian companies has declined in recent years.

Photo 25.--Most Brazilian longliners are vessels converted from other fisheries. This is a former wooden trawler converted as a bottom longliner for operations off São Paulo State. Fabio Olmos

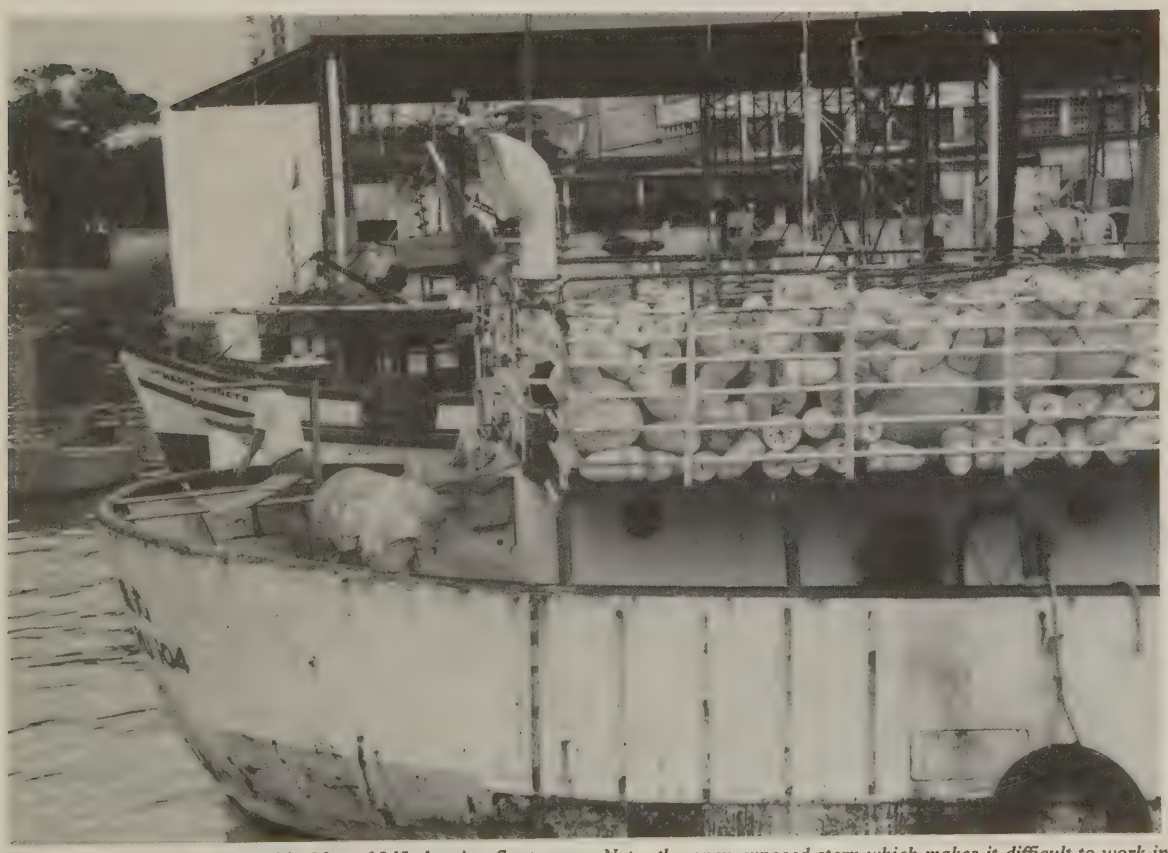


Photo 26.--Stern of the "Tooshin Maru 104" showing float gear. Note the open exposed stern which makes it difficult to work in rough sea conditions. Dennis Weidner

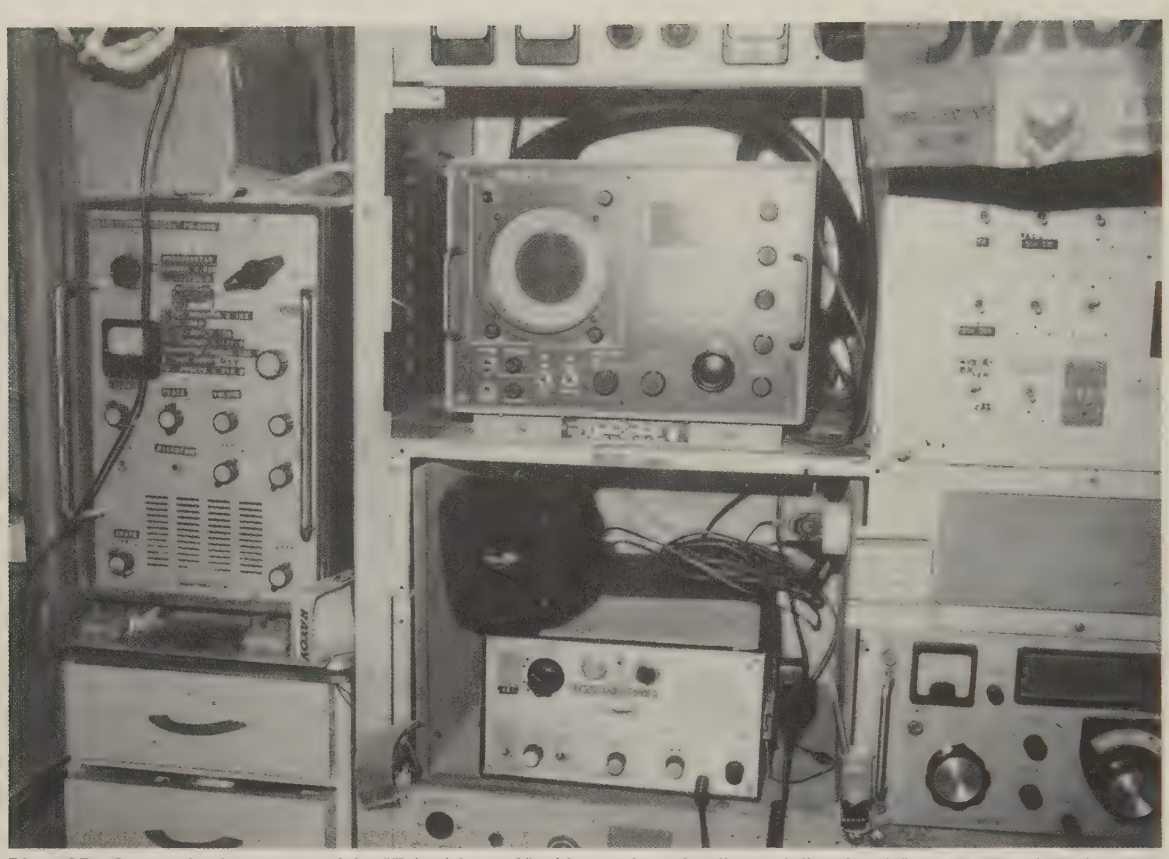


Photo 27.--Communications center of the "Taimei Maru 3" with a variety of radios and directional finders. Dennis Weidner

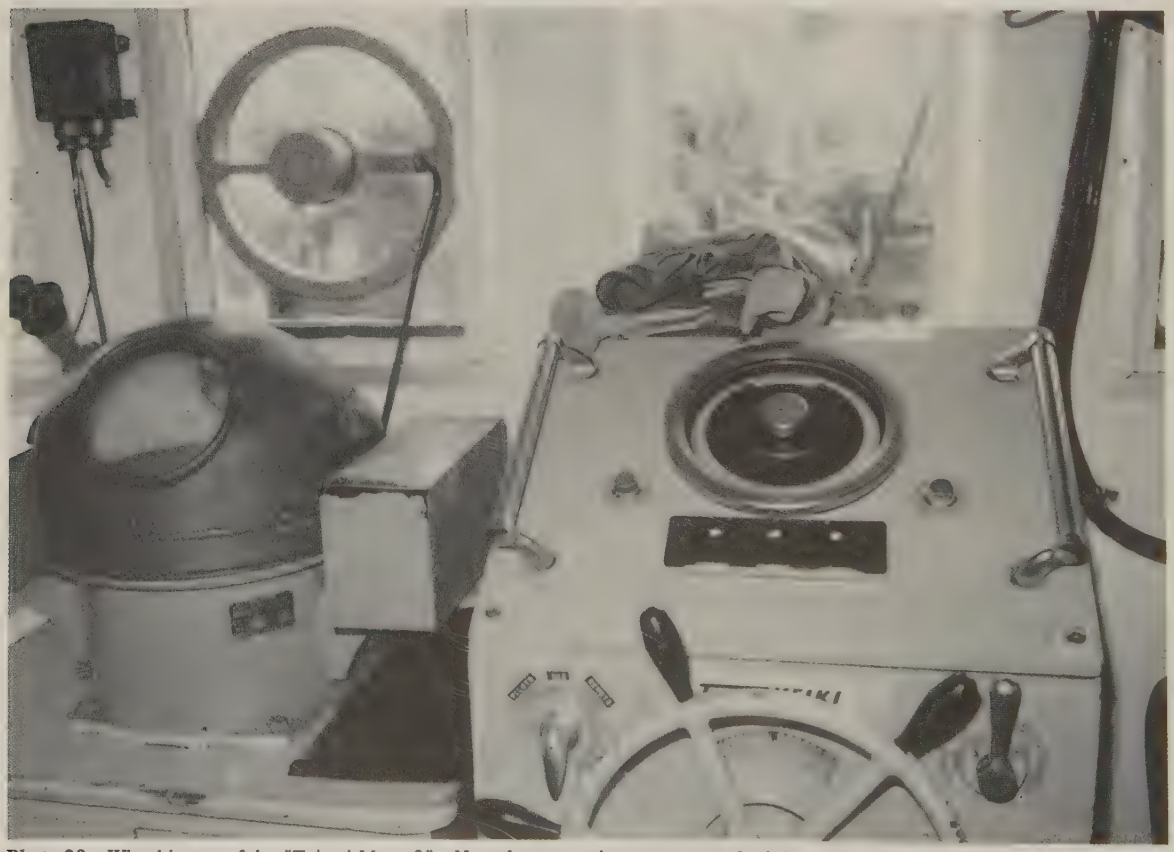


Photo 28.--Wheel house of the "Taimei Maru 3". Note the magnetic compress to the left and the wheel equipped with a gyroscopic compass and auto pilot. Dennis Weidner

Photo 29.--Stern of a Brazilian longline with stowed float gear. Note open stern, making operations in inclement weather difficult. Dennis Weidner

Photo 30.--The "Otero" is one of the few modern, purpose-built longliners in the Brazilian domestic fleet, although two more are under construction in 1988. Dennis Weidner

1989: The fleet expanded significantly to 17 vessels in 1989, primarily because of the development of a longline fishery off northeastern Brazil.[191] Operations off the northeast out of Natal were increased from 3 to 8 longliners (appendix A1c).

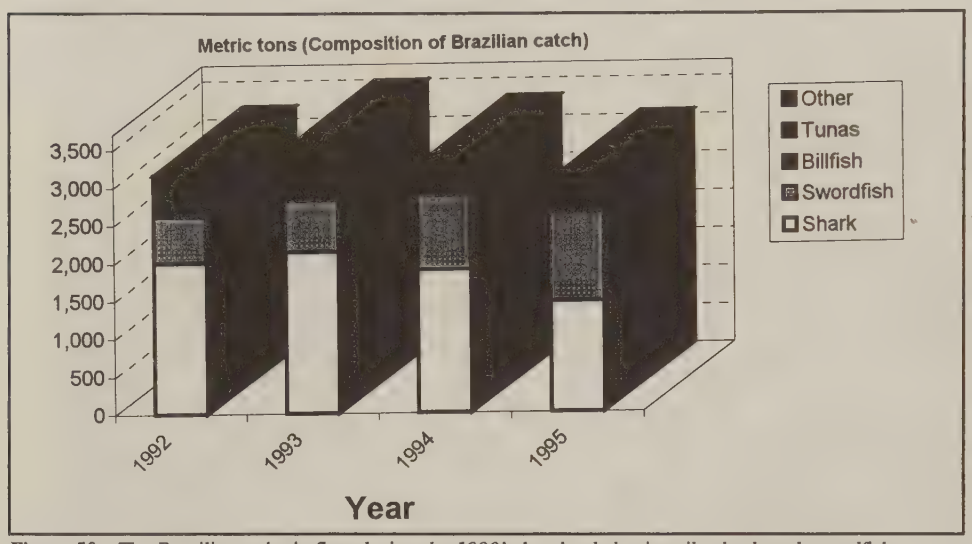


Figure 50.--The Brazilian pelagic fleet during the 1990's has landed primarily shark and swordfish.

1990: The domestic fleet expanded further to a record 21 longliners. The 4 new vessels were evenly divided between the southern and northeastern fleets (appendix A1a).

1991-92: The fleet declined to only 17 longliners in 1991. All of the decline occurred as a result of a withdrawal of vessels from the northeastern fleet (appendix A1c). The Santos-based fleet declined slightly

1993: The fleet expanded to 19 longliners. The fleet continues to be based mostly in Santos, but the 2 additional vessels were added to the northeastern fleet (appendix A1c)

1994: The fleet declined to only 16 longliners, the smallest number since 1989. Vessels were withdrawn from both the southern (Santos) and northeastern fleet (appendix A1c).

1995: The size of the domestic fleet remained constant at 16 longliners, 13 of which were based in Santos and 3 at Natal (appendix A1c).[192]

1996: The Santos fleet consisted of 16 Brazilian longliners in 1996.[193]

1997: Several new foreign longliners entered the fishery in 1997. Several vessels were reportedly shifted to the northeastern fishery. In addition, some Brazilian fishermen deployed a number of small vessels, some as small as 12-m long, reportedly with considerable success.[194] The leased fleet has fluctuated widely from year to year.

1998: No fleet data is available for 1998. Some fishermen experimenting with operations off the northeast reportedly return to the southern fishery because of a variety of problems including limited infrastructure, inefficient port services, poor quality fish, and other difficulties.[195] Some of the Santos-based longliners shifted operations to other ports, especially Itajaí (Santa Catarina), because of increasing costs of operations out of Santos.[196]

b. Leased Foreign Fleet

1) Timeline

1970s: Brazilian companies leased 3 Japanese longliners in 1977 and increased the number to 5 in 1979 (appendix A2a1). The Japanese operated out of Rio Grande do Sul in the extreme south of Brazil.

1980s: Brazilian companies continued to lease Japanese longliners. The number of vessels during the 1980s ranged from 3-6 (appendix A1c).

1990: The contracts with the Japanese companies were

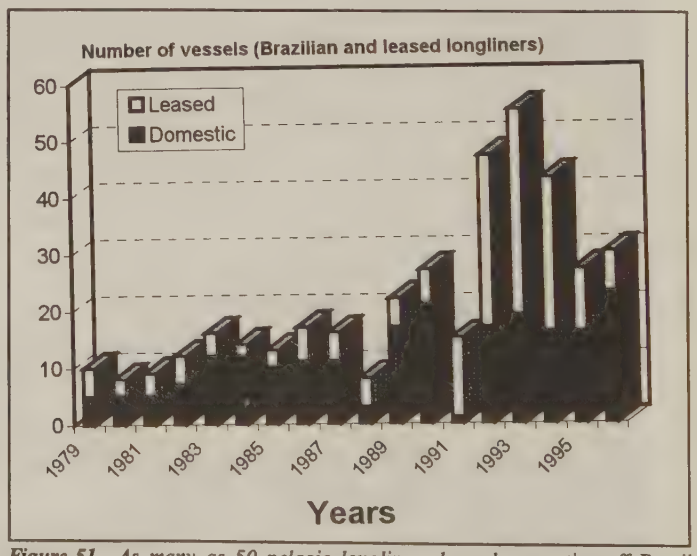


Figure 51.--As many as 50 pelagic longliners have been active off Brazil during the 1990s.

to expire in 1990, but 5 longliners operated at the beginning of 1990. A contract was signed with a Honduran flag-of-convenience vessel for the first time (appendix A1c)

Photo 31.--Many of the older Japanese-built longliners that formed the backbone of the Brazilian domestic longline fleet have been retired or are nearing the end of their useful life. D. Weidner

Photo 32.--The "Rocky" shown here in Santos is one of the many foreign longliners that have operated off Brazil under leasing arrangements. Dennis Weidner

1991: Taiwan longline fishermen for the first time signed contracts with Brazilian companies in Rio Grande do Sul. Only two contracts were signed with the Japanese (appendix A1c). This was a major development because until 1991 the vessel leasing program involved only a small number of vessels, almost exclusively from Japan. The Japanese domination of the program for years was presumably due primarily because of the importance of Japanese-Brazilians in the country's fishing industry and ties with Japanese companies. The entry of Taiwan vessels into the program significantly increased the number of vessels and began the process of attracting vessels from several different countries. The result was to attract fishermen from a variety of countries employing new gear and methods.

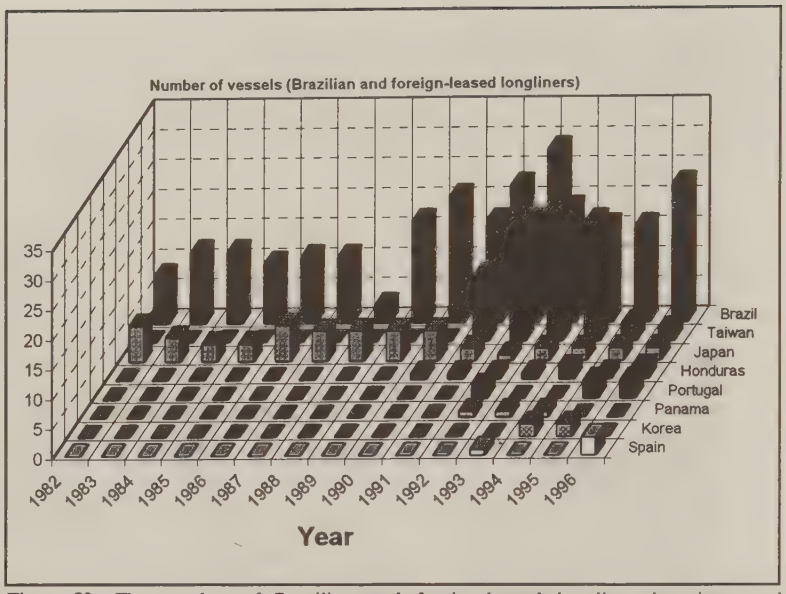


Figure 52.--The number of Brazilian and foreign-leased longlines has increased substantially in the 1990s. The number of foreign vessels declined in 1995-96, but several countries are still active.

1992: The Taiwan fishermen must have experienced good results as they not only increased the number of Rio Grande do Sul contracts to 15, but also signed 10 additional contracts for 11 longliners operating in the north out of Recife in Para State. Contracts with the Japanese declined to 1 longliner (appendix A1c).

Photo 33.--Foreign and Brazilian longliners tied up at the Santos fishing port. Dennis Weidner.

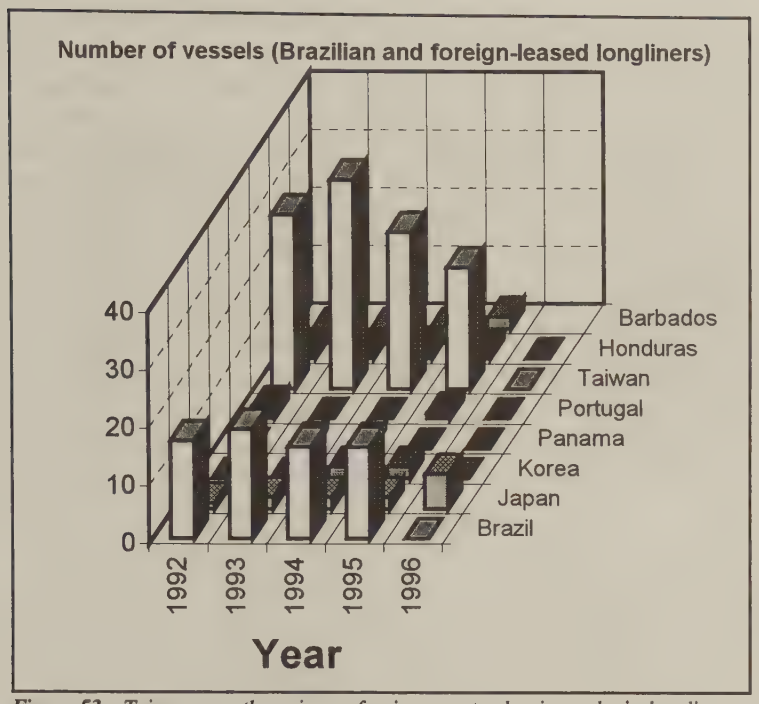


Figure 53.--Taiwan was the primary foreign country leasing pelagic longlines to Brazilian companies during the 1990's.

1993: A very substantial fleet of 36 foreign vessels was active in 1993. Most were Taiwan longliners, but a Honduran and a Japanese vessel were also active (appendix A1c).[197]

1994: The number of foreign vessels participating in the fishery declined in 1994. One source indicated 24 leased vessels were active in both the northern (Para-Recife) and southern (Rio Grande) fishery during 1994. The Para fleet was composed of 10 Taiwan longliners. The Rio Grande fleet was composed of 14 longliners leased from foreign countries: Taiwan (10), Japan (2), and Korea (2).[198] Another source indicated 27 leased vessels, which was reported by ICCAT (appendix A1c).[199] The principal difference in the two estimates was the number of Taiwan longliners reported in Rio Grande do Sul.

1995: The leased fleet declined to 21 longliners. The largest component was the 14 Taiwan-flagged longliners. The other vessels included: Barbados (2), Honduras (1), Japan (2), and Korea (2).[200] The Taiwan vessels primarily operated from Cabedelo (Paraiba).

1996: Many of the foreign vessels withdrew from the southern fishery in 1996. The Taiwan fishermen apparently decided to redirect effort to albacore outside of the Brazilian EEZ. No vessels were active in Rio Grande where they had operated since the 1970s. A few foreign vessels were active in Santos: Barbados (2) and Panama (1).[201]

1997-98: No fleet data is yet available for 1997-98. Available 1997 catch data, however, provide an indication of the scale of operations of the fishermen from the different countries involved in the fishery (appendix E3b3a1). Clearly the leased fleet targeting swordfish increased in 1997, primarily the number of Spanish longliners. Elements in the Brazilian fishing industry have been critical of the leasing program for some time. Some groups would like the program ended. This feeling has increased as increasing concerned has been raised about the status of the south Atlantic swordfish stock. Brazilian fishermen are concerned that the ICCAT management regime will restrict their operations and thus want the Brazilian quota reserved for domestic fishermen. Industry sources report that they met with IBAMA officials in August 1998, to discuss the vessel leasing program. As ICCAT is trying to reduce fishing effort in the south Atlantic, IBAMA reportedly agreed to freeze the foreign vessel leasing program in 1999 at 1998 levels, but deferred any decision to end the leasing program completely.[202]

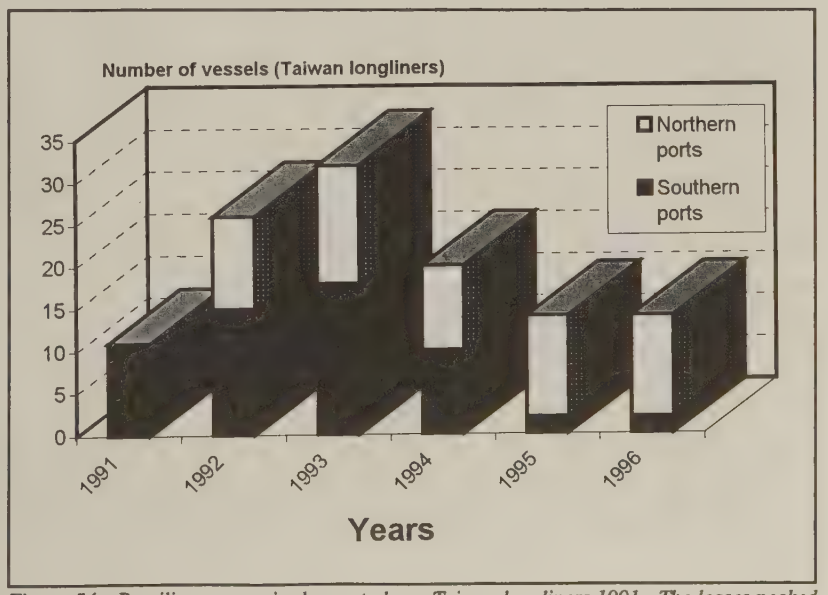


Figure 54.--Brazilian companies began to lease Taiwan longliners 1991. The leases peaked in 1993, but still involved 14 vessels in 1995 and 1996.

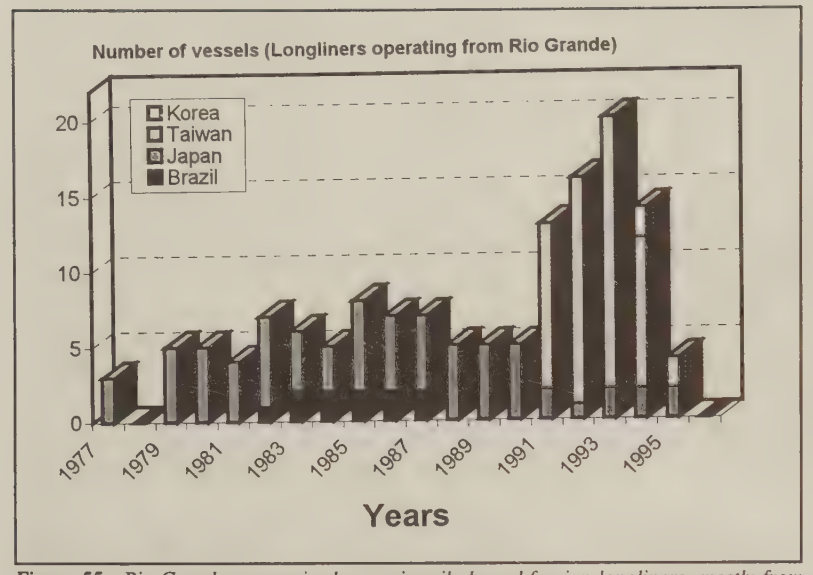


Figure 55.--Rio Grande companies have primarily leased foreign longliners, mostly from Japan and Taiwan, rather than deploy their own longliners.

2) Economics

The authors have little information on the economics of the foreign leased operations off Brazil, but some current information is available on the non-Asian vessels.

Asian vessels: No information available, but given the number of vessel that have participating over extended periods, the arrangements must have been profitable.

Non-Asian vessels. Some limited information is available on the non-Asian countries deploying monofilament for swordfish. A study of the operations of the *Julius* and *Seneca* in 1997-98 indicated that average earnings per trip off northeastern Brazil were about R57,200 (about $54,300). The trips varied from 31-30 days and averaged 14 sets per trip. On average about 500 fish totaling 21.6 tons, of which there were about 290 swordfish weighing 15.6 tons. The swordfish on an average set totaled nearly R46,700 ($44,400), over 80 percent of the total. Most of the rest of earnings came from the tunas also taken (appendix D4a1).[203] This would differ significantly from a domestic longliner which would normally land large quantities of sharks. The single most important expense for the fishermen was fuel, totaling about 50 percent of overall operating costs (appendix D4b1). Brazil is an oil importer and fuel costs are relatively high. Bait is also a major cost constituting about 25 percent of total costs.[204]

3) Fishing countries

The Brazilians have primarily contracted with Japanese companies, but since 1991, longline leasing contracts have been signed with fishermen from several other countries--especially Taiwan.

Barbados: A Barbadian company (Fins and Fathoms) recently deployed 2 longliners, the, off Brazil out of Santos. Efforts to fish out of Bridgetown proved disappointing.[205]

Honduras: The single Honduran vessel deployed off Brazil in 1991-92 is believed to be a small reflagged vessel from Taiwan.

Japan: Most of the Japanese longliners deployed off southern Brazil averaged slightly less than 50 m in length and about 325 gross-registered tons (GRT). They carry crews of about 25 persons and are capable of trips of up to 90 days. They have freezer holds with capacities of nearly 400 t (appendix A2c1a). There were also a few smaller longliners averaging about 27 m with holds of 46-83 cubic m (appendix A2c1b). These smaller longliners have exclusively been deployed in operations off southern Brazil (Rio Grande do Sul and Santa Catarina).[206]

Korea: The two Korean longliners deployed out of Brazil since 1994 were both large vessels (over 200 GRT) (appendix A1b5).

Panama: One large Panamanian-flag longliner was operating out of Santos in 1996. It was owned by a Uruguayan (Trymar) and United States group. Brazil does not, however, report any leasing contracts with Panamanian vessels to ICCAT (appendix A1c).

Portugal: Two Portuguese longliners operated out of Santos under leasing arrangements with a Brazilian company in 1992 (appendix A1c). The Portuguese were active out of Cabedelo and Natal in 1998. The *Rio Pravia*, for example, was working with Norte Pesca in 1998.

Spain: Unconfirmed reports suggest that some Spanish longliners have been leased to Brazilian companies in 1995,[207] but no details are available. ICCAT reports only one small Spanish longliner has operated under the Brazilian flag. That vessel was reported in 1993 (appendix A1b6). Authorities in the southern ports (Rio Grande and Santos) believe such reports are inaccurate. The authors know of only two Spanish longliners (*Cosmos* and an unidentified vessel) operating in northern Brazilian waters in association with the Brazilian Cabedelo company (appendix A2c3).[208] The authors believe that these vessels are targeting swordfish, but have been unable to contact the

Photo 34.—One of China Sea Product's longliners, "Teung Chien," docked at Montevideo. Dennis Weidner.

company to confirm this. Spanish interests may also own some of the non-Spanish flag-of-convenience vessels operating under leasing arrangements. Unconfirmed reports suggest that Spanish interests may be involved, for example, in the Portuguese leased vessels. Spanish fishermen are known to fish extensively off Brazil outside of the 200-mile limit, although only limited information is available to the authors on their operations (appendix A2c5).

Taiwan: Brazilian companies began licensing Taiwan longliners in 1991 when they contracted for 11 vessels. The vessels were operated by several Taiwan companies working out of Montevideo (appendix A2c4). (See: "International.") The number of longliners increased to 15 longliners in 1992 (appendix A1b8). Some observers expected additional vessels to operate in 1993,[209] but details of such operations are not available. The Taiwan longliners average about 42.5 m in length and about 420 GRT. One observer reports vessels of up to 50 meters.[210] The Taiwan longliners carry crews of about 25 persons and are capable of trips of 90-120 days. The vessels were large, modern longliners equipped with freezers capable of producing about 5.7 t daily and freezer holds ranging from 390-520 tons (appendices A2c1a-b). The Taiwan fishermen, however, reduced operations in 1995 and terminated them in 1996 (appendix A1b8). They reportedly decided to shift their focus to albacore on the highseas rather than swordfish off Brazil.[211]

c. Foreign distant-water fleet

Several foreign fleets are active in the south Atlantic off Brazil. The fleet most actively targeting swordfish appears to be the Spanish.

Japan: The Japanese tuna fishery is conducted primarily by small and medium-sized companies located throughout the Japanese archipelago. The small companies have formed several cooperatives organized loosely in Japan Tuna (NIKKATSUREN). The larger companies that were not eligible to form cooperatives are associated separately through the Japan Tuna Fisheries Association (JFTA). These two associations share the same objectives as well as the same Executive Board and full-time directors. Japan Tuna and the JFTA provide a multitude of services to Japanese the tuna/swordfish longliners operating in distant-water fisheries such as the south Atlantic. Services include supplying fuel, bait, and supplies; transporting, storing, processing, and marketing the catch; operating fishing bases; educating and training members; and arranging for foreign crews. Japan Tuna provides an International Division, which helps secure and maintain access to foreign fishing grounds, negotiate bilateral fishing arrangements, gather information on foreign fisheries, and address questions of international controls and conservation.[212] Japanese longliners are thus able to operate for extended periods on the highseas. Supplies and fuel are delivered and the catch transshipped at sea, making the Japanese much less dependent on coastal countries than the other countries operating tuna/swordfish longliners.

Photo 35.--Brazilian nationals make up much of the crews on most of the leased vessels, but a smaller proportion on the vessels leased from Asian countries. Dennis Weidner

Korea: More than 20 Korean companies operate tuna longliners. These companies have not formed a longline association, but the Deep-Sea Fisheries Association represents fishing vessels of all types involved in distant-water operations.[213] Korean operations in recent years have not involved swordfish.

Spain: The Spanish longliners operating in the south Atlantic vary substantially in size. Most are about 190-400 GRT, but there are vessels as large as 735 GRT (Uruguay,

appendices A2d and E2a). Almost all the Spanish longliners are freezer vessels. The larger vessels use lines 60-65 km or more with from 2,000-4,000 hooks, depending on the length of the line and the fishing conditions. There are also many medium-sized vessels deploying longlines averaging about 25 kilometers.[214] Most of the catch is marketed in Spain. Supplies, minor repairs, and crew exchanges are also conducted at transshipment ports. The Spanish vessels often cooperate at sea to some extent, exchanging information on weather and other matters as well as supplies and fuel in emergencies.[215] The vessels are mostly operated by individuals and, as a result, many of the masters are sometimes reluctant to exchange details on grounds and operations, especially while at sea. Many of the masters and crews, however, know each other and often they and their families socialize. Thus in the long run information is rapidly disseminated throughout the fleet.

Photo 36.--Several artisanal fishermen in 1998 re-rigged their vessels with small longlines for swordfish operations off the northeast coast. Dennis Weidner

Taiwan: Five major Taiwan companies are involved in tuna fishing: FCF Fishery, Taiwan Ming Tai Company, Ting Hong Oceanic Enterprise, Tri-Marine International, and Unifishery.[216] Reports from Brazil indicate that many of the Taiwan longliners have been leased from the China Sea Company (appendix A2c4). The relationship between China Sea and the five major Taiwan companies is unknown.

Photo 37.--This Itajaí artisanal boat is one of several that is re-rigging for longline operations out of Natal and other northeastern ports. Dennis Weidner

B. Artisanal vessels

Artisanal vessels have traditionally been powered by sails. In recent years most of the fishermen, especially along the southern coast, have acquired outboard motors.[217] Many fishermen in recent years have also significantly improved their operations by adopting improved gear and methods; small cotton fiber nets have been replaced with larger ones made of more durable synthetic fibers.[218] The authors know of few current detailed assessments of

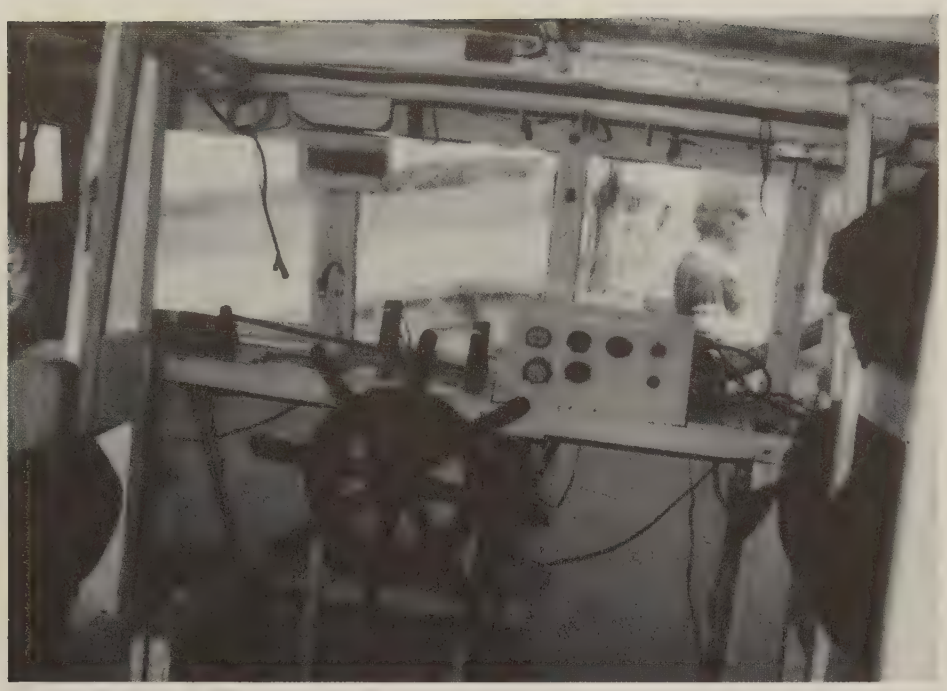


Photo 38.--Interior of one of the artisanal vessels targeting swordfish and other large pelagics along the northeast coast with small longlines. Dennis Weidner

the artisanal fishery nationwide. One excellent 1991 study was prepared for the southern state of Rio Grande do Sul where the fishermen operate primarily in Brazil's largest coastal lagoon, the Lagoa dos Patos. There were about 2,200 artisanal vessels active in 1987 and made up of two size categories. Over 90 percent of the artisanal vessels, or 2,100 vessels, were in the smaller class category (up to 10 tons), and these vessels averaged 7.7 m in length. Another 100 vessels were in the larger category (10-20 tons), and they averaged 13.5 in length.[219] These fishermen, however, do not target swordfish and related species and thus only occasional incidental catches are reported.

Researchers from the Universidade Federal Rural de Pernambuco (UFRPe) in northeastern Brazil have been working with artisanal fishermen. One researcher has reported the successful introduction of longline techniques. One report indicates that U.S. longline methods have been adapted to small boats of only about 12 m with spectacular results. (See "Fleet Operations and Gear".) One observer believes the gear and methods could quickly spread among artisanal fishermen.[220]

C. Recreational vessels

There are several marinas from which recreational fishing is conducted, but mostly for billfish other than swordfish. Sport fishing appears to be popular, although still a minor activity. Several tournaments are held each year. There is a substantial number of modern recreational boats in Brazil, more than any other country in South America. Many of the boats were built locally. The authors, however, have no details on the number and type of recreational boats in Brazil.

Photo 39.--There are marinas in every large city with modern recreational boats. Many are built in Brazil. Dennis Weidner

V. Shipyards

Brazil has a large shipbuilding industry. One report suggests that in the 1970s Brazil was one of the world's 10 leading shipbuilders. The Brazilian shipbuilding industry is capable of building quite large vessels. The Brazilian industry is, however, primarily focused on merchant vessels. The construction of fishing vessels is apparently a minor part of their overall activities. Brazilian fishermen do not conduct distant-water fisheries and generally deploy relatively small vessels in coastal waters. The largest fishing vessels built in Brazil are generally smaller than 200 tons. Commercial fishermen use seiners (sardines and tuna), baitboats (tunas), small trawlers (shrimp and a variety of finfish), trap boats (lobster), and a wide variety of small craft (various species). Many of the small longliners operated by Brazilian fishermen are older vessels converted for longlining operations.

Brazilian yards have the capability to build and repair large ships up to 110 m in length.[221] They have modern equipment, including lateral launch dry docks.[222] While Brazilian yards are capable of building large merchant vessels, the authors know of no large fishing vessels built in Brazil.[223] Brazilian yards have little experience in building fishing vessels over 300 GRT, although one large vessel in the Brazilian fleet was built domestically. Brazilian construction seems to have been limited primarily to trawlers, multiple purpose vessels for the shrimp and lobster fisheries, and small seiners for the sardine and tuna fisheries.[224] The authors have little information on the industry, but believe that most of the fishing vessels used by the domestic fishermen are built locally in Brazilian yards. Scattered press reports also suggest that Brazil exports some fishing vessels, primarily to other Latin American and West African countries.[225] The major Brazilian yards involved in fishing vessel construction are located in Itajaí, Rio de Janeiro, and Santos. Two of the largest companies building and serving vessels in Brazil are both located in Itajaí: Estaleiro Itajaí (formerly the Corena company) and Empresa Brasilera de Construção (EBRASA). Two Santos yards, Wilson Sons and Helis Morcelino, also offer vessel services, but costs in Santos have reportedly increased in recent years and many vessel owners currently are using the Itajaí yards.[226] Some of the Ono brothers' longliners were reportedly undergoing repairs at Itajaí in early 1996.[227]

The authors have few details on construction of longliners or other tuna boats. The first Brazilian tuna vessel with freezer capacity (160 tons), the *Adolfo José*, was believed to have been built by EBRASA in 1991 for FEMEPE at a cost of $1 million.[228] Most of the Brazilian longliners are boats converted from other fisheries or reflagged foreign boats, mostly Japanese boats.

Photo 40.--Brazil has a large ship building industry, but most longliners have been imported or converted from other fisheries.

VI. Fleet Operations

A. Commercial fleet

Swordfish off Brazil are taken almost entirely by commercial fishermen in a multiple species longline fishery also targeting tunas and sharks. The fishery is conducted by both Brazilian and foreign vessels leased by Brazilian companies, but operated by foreign fishermen. The fishing system was essentially the same as introduced by Japanese fishermen who began to longline off Brazil in the mid-1950s.[229] Fishing techniques varied over time as modifications were introduced and market conditions influenced target species. Japanese fishing methods dominated the fishery until the 1990s when fishermen from other countries began to participate in the leasing operations. The involvement of U.S. fishermen has been particularly significant and several Brazilian companies beginning in 1994 began to shift operations to the U.S. fishing system, using monofilament line and more heavily targeting swordfish. The transition occurred very rapidly. About half the Santos fleet was using monofilament by late 1995.[230] When the authors visited Santos in 1996 there were large warehouses stashed to the ceiling with the old, now unused fishing gear. The Brazilian fleet and fleet of leased vessels in recent years has fluctuated substantially.

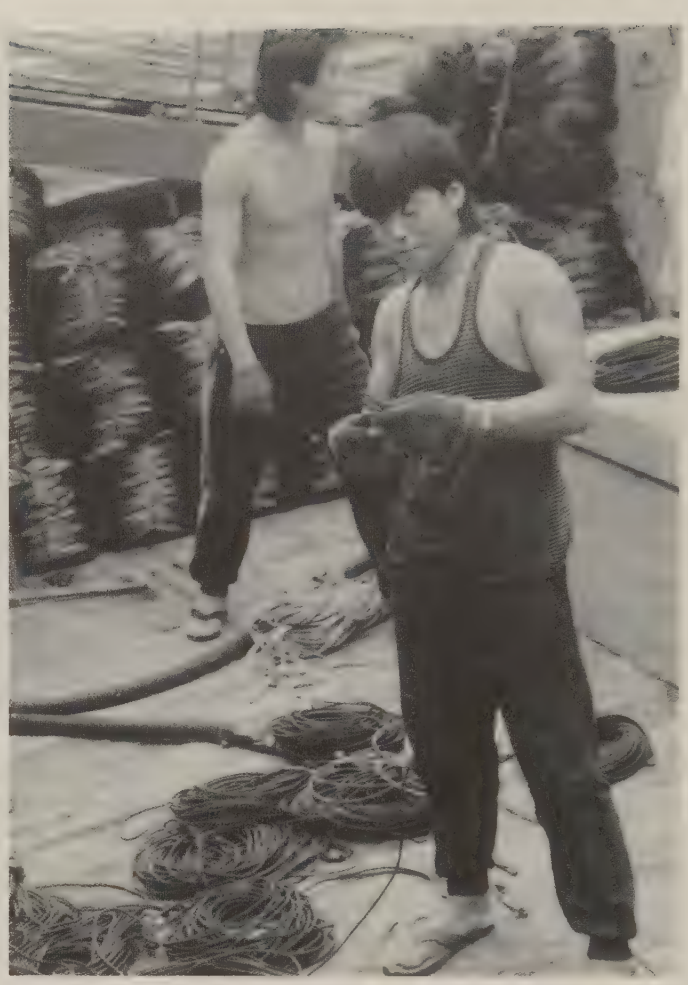


Photo 41.--Taiwan fishermen preparing to coil a braided line for an upcoming trip. Dennis Weidner

Photo 42.--Vessels built in Japan and employing Japanese methods constitute a declining part of the Brazilian longline fleet. Dennis Weidner

Domestic fleet: Some ICCAT reports have noted a very small number of domestic longliners in some years (1988 and 1991) (appendices A1a and A1c). It is likely, however, that data for those years was incomplete. Discarding those anomalous reports, the domestic fleet in the 1990s has ranged from 16-21 longliners. The reasons for the annual fleet fluctuations are not known, but it is noteworthy that the peak of the fleet in

Photo 43.--Domestic and leased longliners are a small, but growing part of the fishing industry along Brazil's northeastern coast. Dennis Weidner

declining Japanese participation may reflect the increasing costs for Japanese companies and problems recruiting Japanese fishermen willing to work in distant-water fisheries for extended periods.[234] Perhaps declining catch rates in highseas fisheries and access problems have encouraged other foreign fishermen to access Brazilian coastal waters.

Brazilian fishing effort has fluctuated substantially, but the fishing effort of the leased foreign longliners has gradually increased in recent years.

1990 and subsequent decline coincided with the expanded foreign participation in 1991. The fleet reached 21 longliners in 1990. It declined to only 16 in 1994, but the very next year a record 23 longliners was noted in 1996. The fleet has since increased to 16 in 1995 (appendix A1a) and more recent reports from Brazil suggest further fleet increase in 1997 and 1998.[231]

Foreign leased fleet: Almost all of the vessels leased from foreign companies during the 1970s-80s were Japanese longliners, but only 3-6 vessels were involved annually. A large number of Taiwan longliners was leased for the first time in 1991 (appendix A1c). Small numbers of vessels from several different countries (Honduras, Korea, Panama, and Portugal) have also been leased since 1991.[232] It is unclear why these foreign vessel owners entered the fishery beginning in 1991. It appears to be more the increasing interest of the foreign fishermen, rather than recruitment efforts by the Brazilian fishermen.[233] The

1977-78: The first leased longliners were contracted by Leal Santos in Rio Grande in September 1977, for operations off southern Brazil. They fished off southern Brazil during September and October, but in November moved to the east (about 20°S) and then to northeastern coast where they operated until returning to the waters off southern Brazil in April 1978.[235]

1979-81: The leased vessels continued to operate off southern Brazil out of Rio Grande with Leal Santos.

Photo 44.--The foreign leased vessels have much larger longline drums than most of the domestic vessels. The drums are carefully covered when not in use to protect the mainline. Dennis Weidner

Photo 45.--The instrumentation on many of the Brazilian longliners, like this Natal-based vessel, is still quite basic. Dennis Weidner

1982-83: The leased vessels continued to operate off southern Brazil until December 1983, when they shifted to northeastern Brazil.[236] The Brazilian domestic longline fleet of 8 vessels was expanded to 12 vessels in 1983. The number of longliners leased from Japanese companies fell from 6 in 1982 to four in 1983 (appendix A1c).

1984: The domestic longline fleet continued at a total of 12 vessels, but one Santos-based vessel was replaced by a small longliner deployed in tropical waters off the northeast coast. The number of leased longline vessels fell to only 3 vessels (appendix A1c). The leased vessels operated off northeastern Brazil until April 1984.[237] The contracts of the Japanese vessels operating in 1983 expired in August.[238]

1985: The domestic longline fleet declined to only 10 vessels because of reductions in the Santos fleet (appendix A1c). Brazilian companies contracted three different Japanese longliners in March 1985.[239] The leased vessels began to regularize operations, fishing in the fall and winter (April-October) in the south. Then during the spring and summer (November-March) they tended to reduce operations off southern Brazil and shift to equatorial waters off northeastern Brazil, Ascension Island, and along the coast of West Africa.[240]

1986-87: The Leal Santos company in Rio Grande do Sul increased the number of leased Japanese longliners to five.[241] A Brazilian company acquired a large longliner (over 200 GRT), but operated it for only 2 years (appendix A1a).

1988: ICCAT reported that Brazilian fishermen operated only three longliners (appendix A1a). It is unlikely, however, that the Brazilian fleet declined to such low levels. This probably reflects incomplete reporting.

1989-90: Brazilian fishermen returned to the longline fishery and deployed 17 longliners in 1989 and a then record 21 longliners in 1990 (appendix A1c). The Leal Santos company in Rio Grande do Sul continued to lease 5 Japanese longliners.

1991: Brazilian fishermen deployed only 17 longliners in 1991 (appendix A1c). Leal Santos in Rio Grande do Sul shifted its leases to Taiwan longliners and increased the number to 11, substantially increasing fishing effort.[242] A Honduran-flagged vessel was deployed (appendix A1b3).[243]

1992: Brazilian fishermen again deployed 17 vessels, but the number of leased vessels increased to 30 longliners (appendix A1c). Most of the new entrants were Taiwan longliners. The number of leased Taiwan longliners increased to 26 vessels. Leal Santos again leased vessels to operate from Rio Grande do Sul. Other Taiwan longliners were also leased for operations out of Recife in Para State. Only 1 Japanese longliner was leased. A few longliners were also leased from Panama and Portugal (appendix A1c).

1993: A record 55 longliners were deployed off Brazil in 1993. Brazilian fishermen deployed 19 longliners and foreign fishermen (mostly Taiwan fishermen) deployed 32 longliners for operations out of Rio Grande do Sul and Recife. Other longliners were leased from Japan, Panama, and Honduras.

1994: The number of longliners declined to only 43 in 1994. Brazilian companies only deployed 16 longliners. The number of leased longliners declined to only 27 vessels, mostly because of declines in the number of Taiwan vessels. Two Korean vessels were leased by Leal Santos for operations out of Rio Grande do Sul, the first Korean vessels to operate off Brazil in many years. Other vessels were leased from Japan, Panama, and Honduras.

1995: One observer reported that Brazilian companies leased a number of Spanish longliners in 1994 or 1995, which has significantly increased fishing effort and presumably the catch off southern Brazil.[244] The authors, however, could find no evidence of legal

Spanish fishing off Brazil. **1996**: The number of leased vessels declined sharply in 1996. None of the vessels which for years operated from Rio Grande do Sul offered leasing arrangements to Leal Santos. Company officials are unsure why the foreign fishermen decided not to operate in 1996.[245] It appears to reflect the changing fishing strategy of the Taiwan fishermen to target albacore on the highseas. Preliminary reports in early 1996 indicate that vessels from several countries (Barbados, Honduras, Japan, and Panama) were operating out of Santos (appendix A2c3).

Photo 46.--Fishing gear stowed on a Portuguese longliner operating out of Natal. Note the floats, buoys, radio transmitters, and signal flags. Dennis Weidner Dennis Weidner

Brazilian longline fishing has been significantly influenced by Japan. Many of the primary companies (Imaipesca, Kaiwa, Ono Brothers, Taiyo, and others) were founded by Japanese immigrants and/or Japanese business interests. The largest Japanese community in Latin America is located in Brazil and is centered in the São Paulo/Santos area and there was considerable interest in fisheries among these immigrants. The Brazilian companies interested in longlining generally contracted for Japanese captains, many of whom became Brazilian residents and raised their families in Brazil. Almost all of the leased longliners for many years were primarily Japanese. Japanese captains were also hired for many of the Brazilian longliners. They were educated in Japan, receiving formal academic training in fishery schools. Some of the current Japanese captains have as much as 40 years experience in fisheries.[246] As a result, Brazilian longline operations have been heavily influenced by Japanese fishing methods. In fact, the most common word for swordfish in Brazil is not the Portuguese "espadarte," but rather the Japanese "mecca". Brazilian fishing companies have had difficulty finding trained Brazilian captains because of the lack of a Brazilian technical fisheries school. Most of the Japanese captains, however, have retired or are reaching retirement age. Companies are now reporting increasing numbers of Brazilian captains.[247] Few young Japanese-Brazilians are pursuing fishing careers, but are rather turning to white collar jobs in business and industry.

Other foreign fishermen have influenced Brazilian longline fishing methods during the 1990s. Brazilian companies have begun to lease longliners from several different countries. The primary country involved is Taiwan, but some vessels have been reported from Barbados, Honduras, Korea, Panama, and Portugal (appendix A1c). Notably no Spanish and United States-flag vessels have been leased. Some U.S. investors, for example, are believed to own some of the Central American (Belizian, Honduran, and Panamanian) flag-of-convenience vessels. One U.S. fisherman was contracted by Imaipesca to try U.S. fishing gear and methods, using mono-filament gear. The experiment reportedly proved stressful for many of the Japanese captains who had operated for years with the same gear and technology.[248] The results using the U.S. system have proven so effective that most Brazilian companies have refitted their vessels and shifted fishing operations to the U.S. system. One company executive expressed some surprise while discussing this development with the authors, exclaiming "I thought Japan led the world in fisheries technology!" As a result of the shift, many of the companies have made substantial investments in the new monofilament gear. Several companies had warehouses full of the old gear, which they had replaced.

Photo 47.--Brazilian longliners tied up at Santos. Note the open work areas at the stern and small size of the longline drum. Dennis Weidner

1. Brazilian operations

The swordfish fishery in Brazil is conducted primarily by longliners. It has been a multiple species fishery targeting tunas, swordfish, and sharks (appendix E2c2a).[249] Longline fishing was introduced in Brazil by the Japanese, and their gear and fishing methods dominated the longline fishery through the 1980s. The first directed Brazilian longline fishery for swordfish was conducted in 1980-81. The fishermen used the traditional multi-filament line.[250] Directed operations for swordfish were popularized in the early 1990s when U.S. fishermen demonstrated the improved profitability when using monofilament line. Brazilian fishing operations appear to have significantly shifted toward directed swordfish operations during the mid-1990s.

The Brazilian longline fishery is conducted quite differently on the northern and southern fishing grounds.

Northern fishery: The northern fleet normally operates from December to March or April, primarily around St. Peter and St. Paul cays (1°N/29°W). The fishermen for years caught yellowfin tuna and to a lesser extent flying fish. (See: "Grounds.") The rest of the year the fleet targets night sharks (80 percent of the catch) on the shallow oceanic banks that are common off northeastern Brazil. These banks promote very strong topographic resurgence that result in nutrient enrichment, which support fodder species that attract sharks. Fishermen report high shark yields as a result.[251] The Universidade Federal Rural de Pernambuco (UFRPe) is studying this phenomenon as part of the Brazilian Economic Exclusive Zone Research Project (REVIZEE).[252] Swordfish are only taken as a bycatch of the yellowfin and shark fisheries, which conducted operations based on Japanese technology. The introduction of U.S. and Spanish methods during the 1990s, however, has created greater interest in swordfish. The operations of the *Seneca*, a U.S. vessel leased by the Norte Pesca company, has had a particularly big impact. (See: "Companies.") Several Brazilian vessels have begun to conduct directed swordfish sets. They are experimenting with squid as bait and employ light

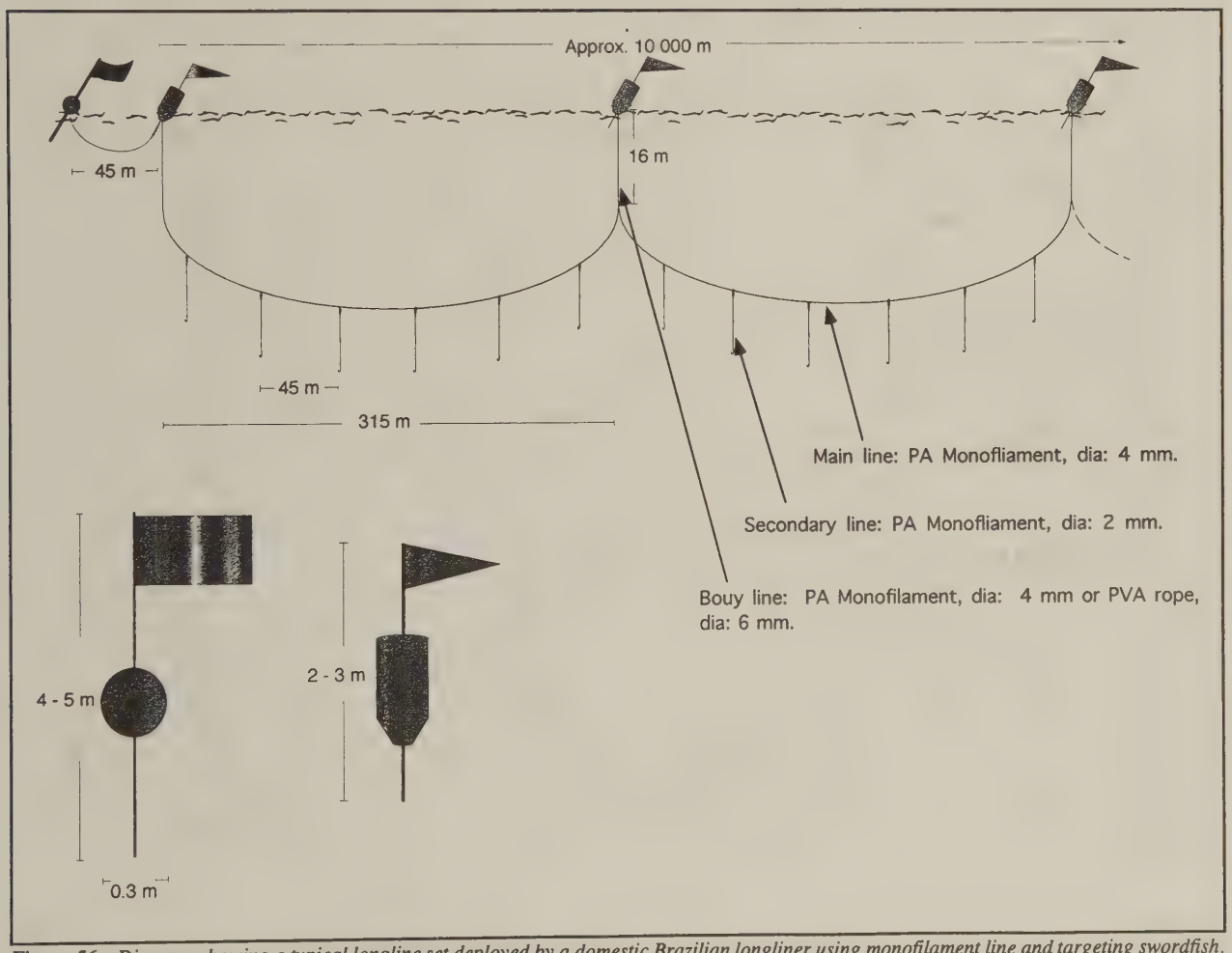


Figure 56.--Diagram showing a typical longline set deployed by a domestic Brazilian longliner using monofilament line and targeting swordfish. Mat Broadhurst

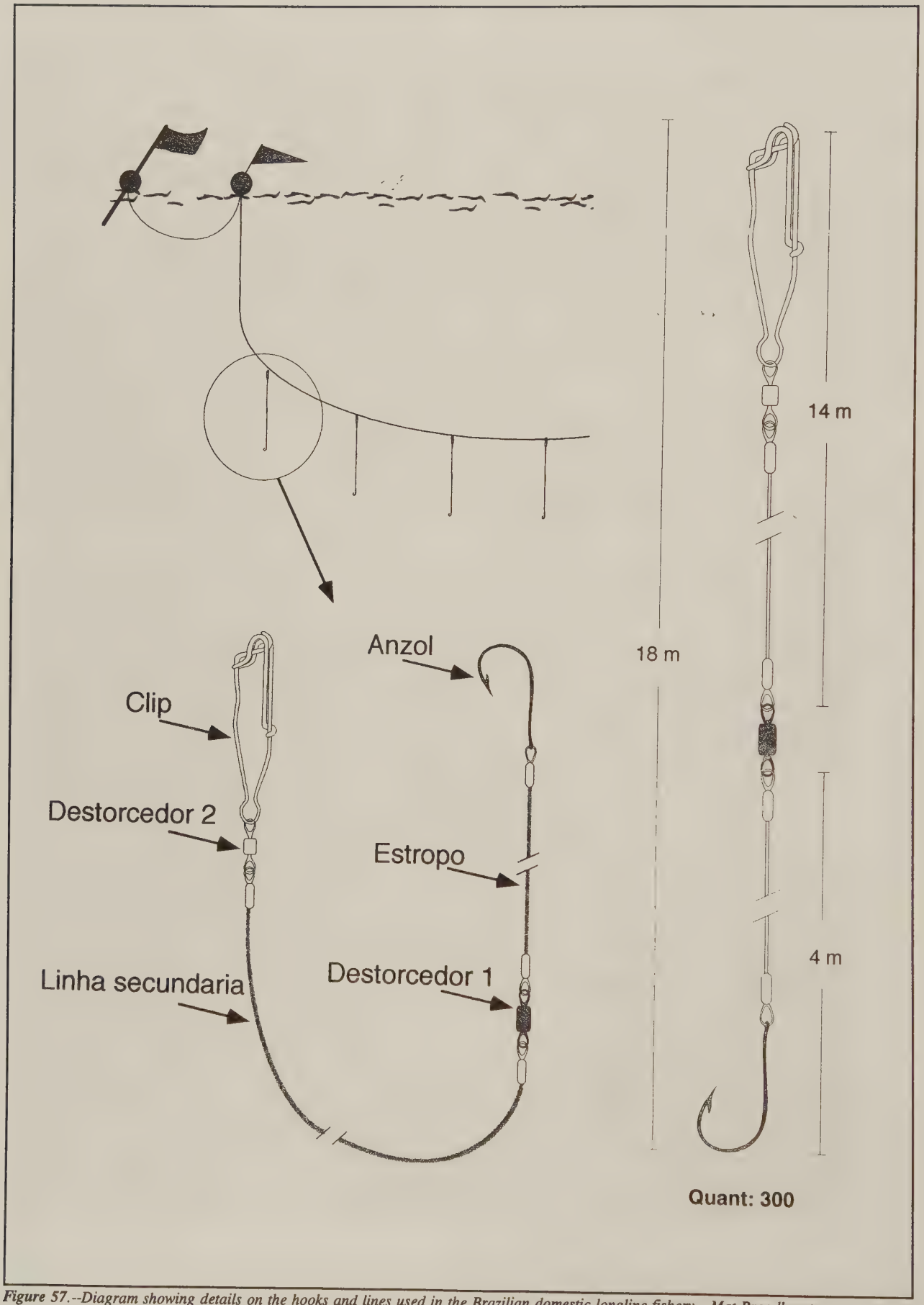
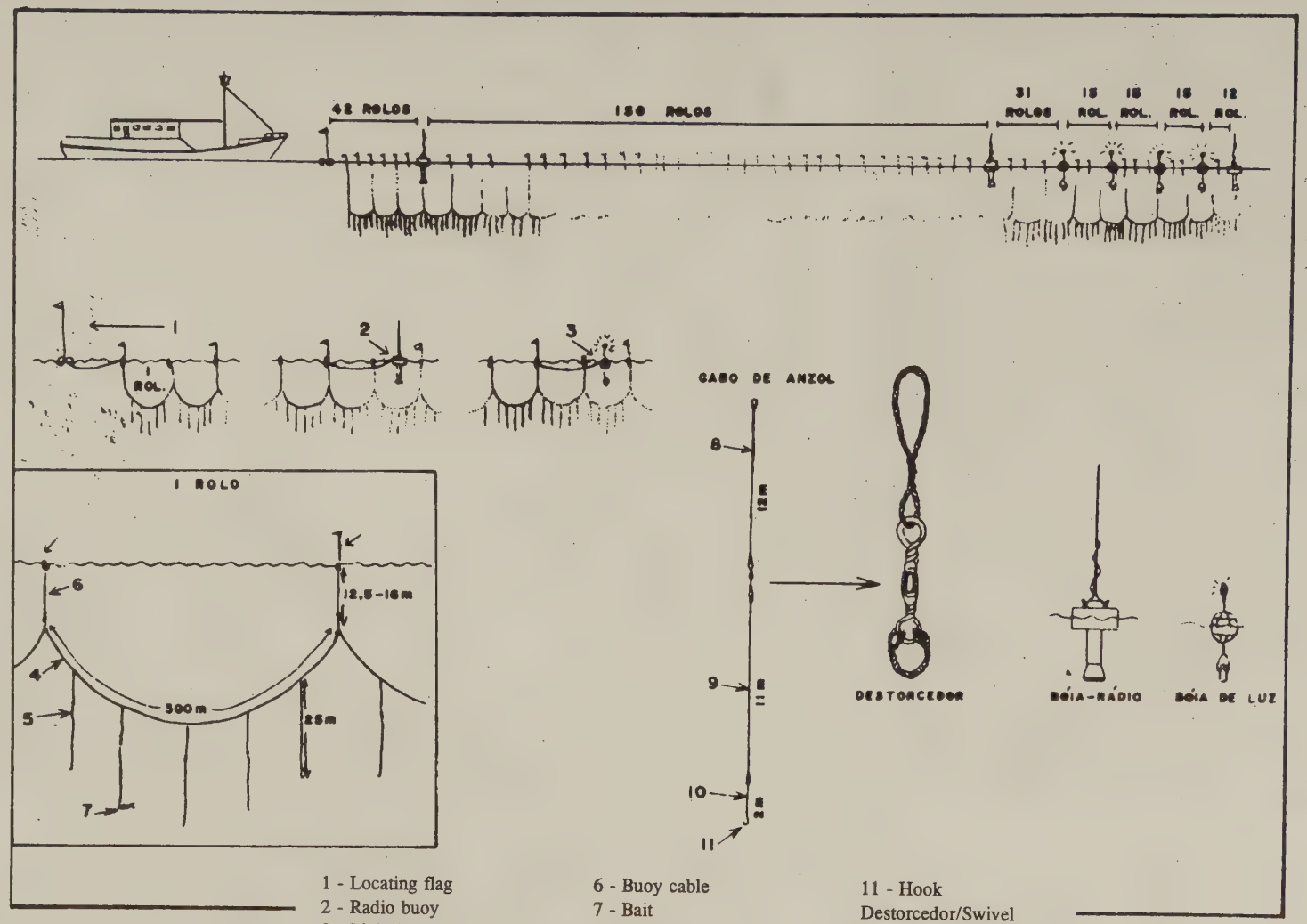


Figure 57.--Diagram showing details on the hooks and lines used in the Brazilian domestic longline fishery. Mat Broadhurst



1 - Locating flag
2 - Radio buoy
3 - Light buoy
4 - Main line
5 - Secondary/hook line
6 - Buoy cable
7 - Bait
8 - Burã
9 - Sekiyama
10 - Aço cable/leader line
11 - Hook
Destorcedor/Swivel
Rolos/Line rolls or baskets

Figure 58.--Diagram showing details on the hooks and lines used in the former Japanese-style Brazilian domestic longline fishery. Amorim and Arfelli

sticks. One local observer believes that the focus of the fishery could shift quickly if these fishermen experience good results.[253]

Southern fishery: The southern fishery has also been a multiple species fishery, but swordfish constitutes a much more important part of the catch than in the north. The southern Brazilian fishermen, primarily out of Santos, have substantially shifted operations from the old Japanese system to U.S.-style monofilament line using light sticks, and are increasingly targeting swordfish.[254]

Photo 48.--The "Transmar I" targets tunas and flying fish around the islands off Brazil's northeastern coast, the long trips necessitate the added on-deck fuel tank. Dennis Weidner

Photo 49.--Floats, pennants, and radio transmitters used by some of the larger Brazilian longliners. Dennis Weidner.

Brazilian longline fishermen have used two different systems; the Japanese multi-filament system targeting multi-species and the U.S. monofilament system focusing more on swordfish.

Japanese system: The Brazilian-flag longliners are mostly smaller, older vessels of Japanese origin. They make relatively short trips of 20-25 days. The fishermen generally begin to deploy their lines about 1-2 days out of port, which would mean about 17-20 fishing days on an average trip.[255] The length of the trip is limited by the need to land high-quality fresh product. Brazilian longliners using the Japanese fishing system carry about 300 baskets, each containing 4-7 leader lines with hooks. Thus each set may consist of 1,200-2,100 hooks, but usually average about 1,500 hooks. The large number of hooks requires a significant effort to bait, deploy, and retrieve. As a result, relatively large crews of about 17 are common. Each basket of hooks is deployed on about 300 m of main line. The full line can be as long as 90 kilometers. Each basket of hooks is supported by two buoys. The hooks are set at depths from 60/70-120 m depending on the conditions and target species.[256] Captains targeting swordfish, often set the hooks deeper and earlier (9:00 pm) than when targeting tuna.[257] The fishermen generally use sardines (*Sardinella brasiliensis*), chub mackerel (*Scomber japonicus*), or squid (*Illex argentinus*) for bait, but a few other species are also used occasionally.[258] Another observer indicates, for example, that a

Photo 50.--These floats are attached to the gangions from the main line. Dennis Weidner.

Photo 51.--Shark and albacore tuna put aside for the crewmen as the catch is being landed. Dennis Weidner

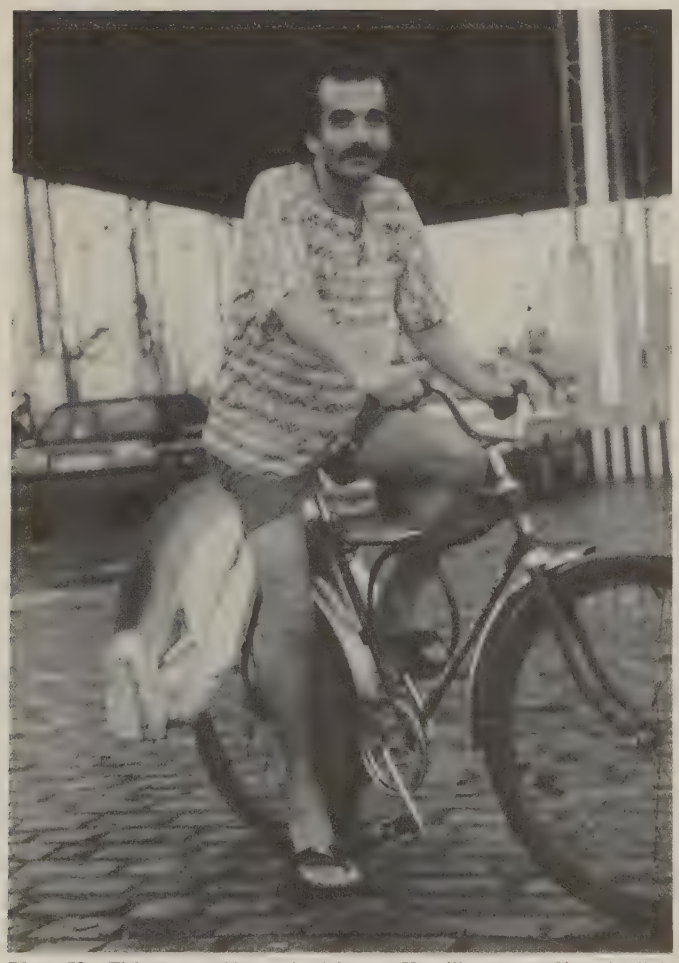


Photo 52.--Fisherman taking a shark home. He will eat part of it and sell the rest to neighbors. Dennis Weidner

Photo 53.--Cook preparing a meal aboard a Brazilian longliner. Dennis Weidner

Photo 54.--The author discussing longline fishing with union officials in Rio Grande. Union members were adversely affected when leased vessels withdrew from Rio Grande in 1986. D. Weidner

few fishermen also use mackerel.[259] The Brazilian fishermen appear to target swordfish much more heavily than the foreign fishermen operating leased vessels (appendix E3b1b). With few exceptions, the Brazilian fishermen generally landed more swordfish than the Japanese leased vessels during the 1970s and 1980s. This was in part because the Brazilians were more focused on the U.S. market where the market for swordfish was strong. Swordfish also involved more shallow sets, which were easier for the smaller Brazilian vessels. In addition, as the domestic market for sharks developed in Brazil, the shallow sets with higher shark bycatches made more economic sense. The domestic focus on swordfish was to increase even more with the introduction of U.S. monofilament gear.

U.S. system: The Brazilian fishermen began to radically change their longline methods during the mid-1990s. A few Brazilian fishermen were impressed with directed monofilament swordfish operations they observed in the United States. U.S. fishermen also demonstrated the U.S. longline fishing system in Brazil. As a result, Brazilian fishermen began shifting operations from Japanese methods and gear to the U.S. monofilament fishing systems. This shift, once started, has been very rapid. Initially there was some reluctance to introduce the new methods. Many of the Brazilian captains were Japanese immigrants who had been fishing for years and objected to new methods. These mostly elderly Japanese played a key role in the development of the Brazilian longline fishery. They studied in Japanese fisheries training schools at a time when there was no fisheries training available in Brazil. The Japanese, faced with the economic dislocation and poverty of post-World War II Japan, emigrated to Brazil. There academic training predated many modern technologies, but they successfully used largely intuitive methods to determine where to set their lines. Most have now reached retirement age and are generally unwilling to try new methods--especially such a radical change as the U.S. monofilament system. Younger Brazilian captains more open to new methods are being appointed. Some companies have hired U.S. captains or contracted for foreign boats with U.S. captains. Another factor slowing the introduction of the U.S. system was the cost. Considerable costs were associated with retiring still serviceable gear for

the new monofilament gear. New Brazilian captains and most companies, however, clearly saw the advantages and the U.S. system is now in widespread use. The Brazilian longliners equipped with the new monofilament line deploy about 700-1,100 hooks per set on about 20-45 km of mainline. Each hook is attached to the mainline by a snap and deployed at intervals of 30-40 meters. Light sticks are hung above each hook to attract the fish or prey species which in turn attract swordfish or other predators.[260] U.S. fishermen usually use squid for bait. Shorter mainline and branch lines are usually employed.[261] The hooks are generally set at intervals of 30-40 meters.[262] Another report suggests monofilament mainlines of up to 80 km, deploying an average of about 800 hooks (range = 300-1,200 hooks). The hooks are set closer to the surface than in the Japanese system, at 45-80 m primarily to target swordfish.[263] The fishermen using the U.S. system don't use baskets as the Japanese system employs, but instead deploy one continuous line, supported by buoys. The shorter line and smaller number of hooks means that the U.S. fishing system is less labor intensive and, as a result, the crews on the vessels using the U.S. system are much smaller (8-10 persons) than those using the Japanese system (17 persons).[264] The trips made by the vessels using the U.S. system are shorter than those of the vessels using the Japanese system.[265] U.S. fishermen generally prefer to use squid for bait.[266] Brazilian fishermen using monofilament also extensively use squid (mostly *Illex argentinus*) which is occasionally treated with bioluminescent dyes (green, yellow, orange, or red) to attract the fish.[267] The Brazilian fleet does not currently make extensive use of satellite data to help spot the most promising locations to set their lines. The companies use the instrumentation on some of these vessels to help direct their smaller, less well-equipped Brazilian-flag boats. One Brazilian university (FURG) is currently considering a possible project to provide real-time satellite data to Brazilian fishermen.[268]

Photo 55.--Swordfish and shark being landed in Santos. Note that the swordfish is in a protective bag and the less valuable shark is not. Dennis Weidner

2. Leased operations

Brazilian companies began to lease foreign longliners in 1977. The leased vessels tended to be larger than the domestic longliners. The vessels leased from foreign countries during the 1970s-80s were mostly Japanese and used Japanese fishing gear and methods. Brazilian companies began to lease larger numbers of Taiwan vessels in 1991 and subsequently a few Korean vessels. The Taiwan and Korean vessels used essentially Japanese-style fishing methods, although the target species often varied. The Brazilian companies also began leasing a few vessels from other countries (Honduras and Panama) in 1992. These were flag-of-convenience vessels and the owners were from other countries (the United States, Spain, and others).[269] Although only a small number of vessels were involved they played a major role in introducing U.S. monofilament fishing gear to Brazilian fishermen. The Japanese crews are mostly Japanese or other Asians (Koreans and Chinese). The other leased vessels employ a wide diversity of nationals. The larger leased vessels have crews of up to 28-30 (5-6 officers and 23-24 crew members).[270] The vessels are generally managed by the foreign owners. As one Brazilian company official explained, "They are the ones who know how to longline."[271] The Brazilian companies put nationals aboard the vessels to supplement the crew and to learn longline techniques. As a result, by the mid-1990s substantial numbers of Brazilians had become skilled in longline fishing techniques.

Photo 56.--Many Taiwan longliners were used for both leased and distant-water operations off Brazil. Note the enclosed, protective work area at the stern. D. Weidner

Japan: The Japanese fishermen set longlines of about 135 kilometers. The longlines are made of kuremona with twisted multi-filaments. The mainline is attached to a string of buoys (each 40-45 cm in diameter). The fishermen attach radio or light buoys to about every 20 buoys. The fishermen deploy about 2,130 hooks per set. The Japanese longline fishermen have gradually changed their operations since initiating operations from Rio Grande in Rio Grande

Photo 57.--Radio beacons which will be attached to a longline set by the Brazilian longliner "Itapui." Dennis Weidner

Photo 58.--Radio beacons and floats attached to Brazilian longline gear. Many Brazilian vessels are still not equipped with this gear and captains have lost whole sets. Dennis Weidner

Photo 59.--Instruments, including a fish finder and global positioning system, aboard a Brazilian longliner. Dennis Weidner

Photo 60.--Search lights are used at night while setting longlines. Also note antennas and radar equipment. Dennis Weidner

Photo 61.--Japanese vessels, fishermen, gear, and technology have had a major impact on the Brazilian longline fishery. Dennis Weidner

Photo 62.--Hook used by one company utilizing Japanese fishery methods. Dennis Weidner

Photo 63.--Boxes of longline hooks and leader line at Kawai. Dennis Weidner

Photo 64.--Most Brazilian companies have shifted to monofilament line and in 1996 large quantities of now obsolete gear, such as this braided line, was piling up in warehouses. Dennis Weidner

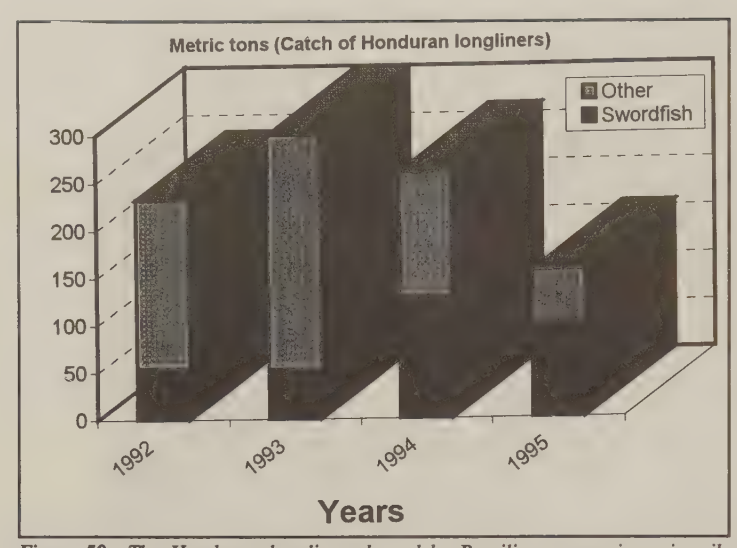


Figure 59.--The Honduran longliners leased by Brazilian companies primarily caught swordfish in 1995, but the catch composition has varied widely.

do Sul during 1977. Baskets with 16 hooks have been employed permitting deeper operations.[272] The Japanese increased the depth of the secondary lines (vertical lines with hooks suspended from the mainline) from 22 to 55 m and have changed the depth of the buoy lines supporting the mother lines from 20 m to a wide variety of different depths (15-60 m). The Japanese made these changes primarily to better target bigeye tuna, especially when fishing in warm equatorial waters (off northern Brazil) during the spring and summer.[273] The Japanese vessels tend to be larger than the domestic longliners and make substantially longer trips (averaging about 60-70 days) than the Brazilian flag vessels.[274] Rio Grande fishermen report some trips are as long as 90-120 day. Japanese vessels generally have crews of about 21 fishermen, usually including about 5 Brazilians. The longer trips create some problems as the Brazilian crew members prefer shorter trips. As a result, the unions have negotiated financial inducements for longer trips (appendix A2e3).[275] The Japanese and Taiwan fishermen often insist on using bait which they have brought/imported from their own country. Fishing methods vary significantly depending on whether the vessels are deployed in warm equatorial water or the more temperate water off southern Brazil.

Southern Brazilian grounds: The fishermen deploy mother lines of about 270 m, supported by buoy lines with vertical drops of about 15 m (figure 60). Vertical lines with hooks are spaced at about 45 m intervals on the mother line.[276]

Equatorial grounds: The mother line between buoys is extended to about 700 m and the vertical drop of the buoy line supporting the mother line is increased to 35-40 meters. The number of hooks per line is to 11-16 and the number of buoy lines is reduced from about 500 to 160. The number of hooks per set, however, remains about the same.[277] The Japanese leased vessels have primarily focused on operations off southern Brazil. One report indicates that from 1977-1991, the leased vessels deployed 23.9 million hooks, of which 19.4 million or over 80 percent were deployed off southern Brazil (appendix D1b).[278]

Honduras: Brazilian companies first leased a Honduran longliner in 1991. The Honduran vessels first operated from Santos, the major Brazilian port, in 1994. The number of vessels involved has been very small, but the results from the U.S. longlining methods they employed have had an impact on the Brazilian fishery. Details on the U.S. monofilament system are described above. The Honduran fishermen mostly use squid for bait.[279]

Korea: Only a few Korean longliners have participated in the Brazilian fishery. They use fishing systems very similar to the Japanese. The crews tend to be slightly larger, usually about 23 persons including 6 Brazilians. Like the Japanese they generally supply their own bait. They tend to deploy about the same number of hooks (2,180) as the Japanese.[280]

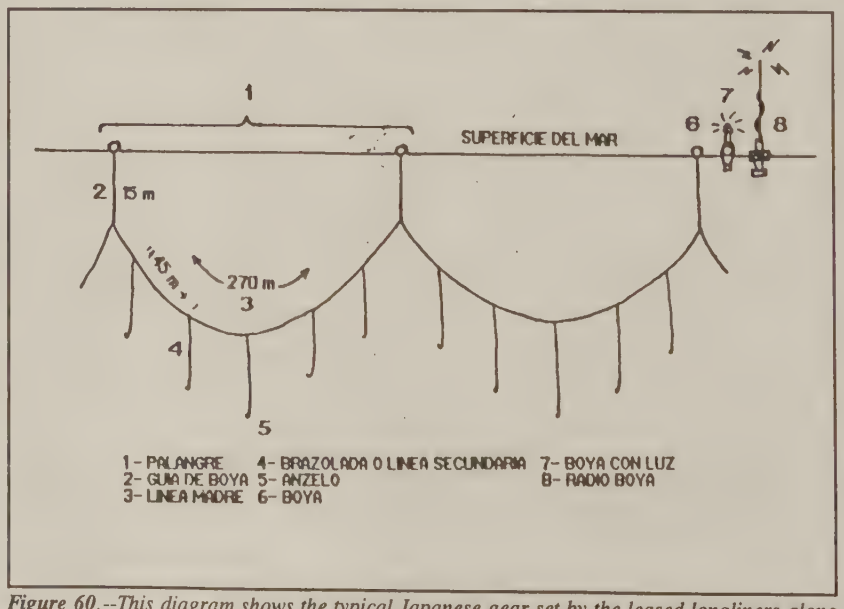


Figure 60.--This diagram shows the typical Japanese gear set by the leased longliners along Brazil's southern coast during the 1980s and early 1990s. Menezes de Mello, Vaske, and Castello

Photo 65.--Taiwan fishermen preparing longline gear. The Japanese-style fishing employed by Taiwan fishermen is very labor intensive. Dennis Weidner

Panama: Brazilian companies also began leasing Panamanian flag-of-convenience vessels in 1992. These vessels are believed to be owned at least in part by Spanish interests. They also have deployed monofilament lines.

Taiwan: The Taiwan longliners that have been deployed out of Rio Grande and other ports since 1991 basically use the same fishing system as the Japanese. The crews tend to be slightly larger, usually about 23 persons including 6 Brazilians. Like the Japanese they generally supply their own bait. Taiwan fishermen explained to one leasing company that the cost of fishing operations are so high that they were unwilling to take the risk of using unfamiliar local bait.[281] They tend to deploy more hooks (about 2,840) than the Japanese.[282]

3. Distant-water operations

Several countries have active distant-water longline fisheries in the south Atlantic. Much of that activity has centered more on the eastern south Atlantic off Africa, but in recent years distant-water fishing by some countries has shifted west closer to the Brazilian coast. The Asian countries (Japan, Korea, and Taiwan) utilize similar gear, although the fishermen have developed some innovations, largely associated with variations in target species. The Spanish and U.S. systems have some similarities as both countries have focused on swordfish. Many of the differences are based on the fact that the Spanish conduct a major distant-water fishery producing mostly frozen swordfish. The U.S. south Atlantic operations are very limited and essentially constitute gear and equipment developed for a largely coastal fishery delivering fresh product.[283]

Japan: Japanese distant-water operations outside 200-miles are similar to the gear and methods deployed by the leased vessels described above.

Korea: Korean fishermen have shifted operations to target sharks and rays. Details on the fleet operations involved are unavailable.

Spain: Spanish fishermen have played a minor role in the development of the Brazilian longline fishery. While their fishermen have been active in the south Atlantic since the late 1980s, it was not until 1986 that Spanish companies signed leasing arrangements with Brazilian companies. Thus Spanish gear and methods have not played a major role in Brazil. Many of the Spanish vessels operating in international waters in the

south Atlantic are operated by small, family-owned businesses. Most operate only one or two vessels (Uruguay, appendix E2b).[284] Most of the fishermen are not associated with larger fishing companies, but prior to departure do make arrangements with the wholesalers and companies offering the highest prices. Most vessels have crews of about 15-17 with somewhat bigger crews on the larger vessels. Some older vessels require larger crews. They primarily operate out of Vigo, but may return to that port as infrequently as once a year. Almost all of the fleet returns at least once a year so the vessel can be inspected and serviced. The Spanish south Atlantic operations are primarily for frozen swordfish. Fishing trips are often about 2-3 months. The gear varies from vessel to vessel, but the fishermen normally deploy an 8-10-km mainline with hooks spaced every 20 m, or about 400-500 hooks. The bait is usually squid or Spanish mackerel (wahoo). The Spanish fishermen are reportedly experiencing a lot of problems with killer whales. They often have to leave an area when a killer whale pod appears. The line is set during the early evening and retrieved near sunrise. They report shark bycatches. The species retained are mostly makos, but also some white sharks--depending on the fishing grounds. Operations are conducted along both the South American and African coasts, from about 5°N-35°S(appendix A2c5). Many of the Spanish longline fishermen do not like to go much further south as the Atlantic becomes much rougher and colder. The grounds vary seasonally. Operations off Africa are common from December to February and then move closer to the South American coast during June and July. The greatest effort, however, is off Africa rather than South America. The catch is gutted and bled and the frozen trunks are stored at -30°C. The catch is transshipped at different points, commonly Cape Town, Montevideo, or Walvis Bay. There are currently no transshipments through Brazilian ports, although some product was reportedly transshipped there during emergency port calls during the late 1980s.

Taiwan: Taiwan operations and catch composition have varied over time, but in recent years have focused primarily on albacore, which can account for over 90 percent of their catch. Operations also vary seasonally. The Taiwan vessels generally operate off northern Brazil from October to March and, as a result, the proportion of marlin increases somewhat. They move south to waters off southern Brazil and Uruguay from April to September. The crews are entirely Taiwan or Chinese for operations in international waters. There is a substantial shark bycatch, much of which is

Photo 66.--Artisanal fishermen have been taking sharks for years. These fishermen in 1962 will dry much of the flesh. They also crudely extracted oil from the liver. Ernesto Tremel

discarded after finning, depending on the amount of hold space available. The Taiwan fishermen also report significant problems with killer whales. Fishing trips can be 5-6 months long. The longlines are much longer than the Spanish lines, often 50-60 kilometers. The line is generally set at dawn and brought aboard during the late afternoon. The albacore is frozen at -20°C, although bigeye destined for the sashimi market is frozen at -50°C. All of the albacore catch is frozen and is transshipped at Montevideo to Puerto Rican canneries or Asian countries.[285]

United States: U.S. fishermen have conducted only minor distant-water operations in the south Atlantic. Much of that activity has been conducted from Montevideo because Brazilian ports cannot be used to transship. (See "Transshipment".) U.S. fishermen have, however, worked extensively with Brazilian and Uruguayan fishermen and, as a result, the monofilament gear and American-style fishing now dominates the longline fishery in both countries. One U.S. longliner began working under a leasing arrangement in 1996 out of the northern port of Natal, further exposing U.S. gear and methods to the Brazilian fishermen. Even Brazilian artisanal fishermen are adopting a scaled-down version of the U.S. monofilament system. Details on the U.S. gear and methods are discussed above.

B. Artisanal

Brazil has the largest artisanal fishery in Latin America. The Brazilian fishing industry was almost entirely artisanal until the 1940s. It was not until Japanese immigrants during the 1940s began introducing modern methods that the first commercial fishing operations commenced in Brazil. Primitive conditions continued to prevail in the country's artisanal fishery well into the 1960s. Many of the early commercial operations were to produce frozen shrimp and lobster tails for export. Most of the domestic market was supplied by the large artisanal sector.

Many artisanal fishermen have since motorized their vessels and adopted improved gear and equipment. The artisanal fishermen continue to supply most of the seafood consumed in Brazil. The fishermen primarily harvested demersal species, but in recent years they have been taking larger quantities of pelagics, including sharks and billfish--mostly sailfish. The artisanal fishermen have not often taken swordfish because of its more offshore range. Some observers believe that a new fishery using small monofilament longlines may make it possible for the artisanal fishermen to eventually harvest substantial quantities of swordfish. A few artisanal fishermen initiated operations with small monofilament longlines in 1998 and the results that they are reporting are very promising.

Photo 67.--The limited range of most of Brazil's large number of artisanal fishermen, like this driftnetter, means that there is virtually no swordfish catch. Dennis Weidner

1. General

The authors have little data on the number of fishermen or craft involved in the Brazilian artisanal fishery, but it probably equals or exceeds that of the rest of South America combined. Reports from the early 1960s suggest that as many as 300,000 full and part-time artisanal fishermen were active in the fishery during the 1960s.[286] Brazilian officials reported in 1986 that there does not appear to have been any change in the fleet's composition during recent years.[287] The fleet is especially numerous along the northeastern coast. There is also a substantial number of artisanal fishermen involved in inland freshwater fisheries. One report suggests that there is a particularly large concentration of artisanal fishing activity in the Rio de Janeiro area.[288]

The artisanal fishery actually comprises a wide range of vessels and gear.

Vessels: Undecked canoes powered by sails, called *jangadas*, were the craft primarily used by the artisanal fishermen. Estimates of the number of artisanal craft has varied from 50,000-120,000 craft, many simple canoes, during the 1960s-80s. The number of motorized boats through the 1970s continued at extremely low levels.[289] This did not begin to change significantly until the late 1970s. Gradually, outboard motors replaced sails and small-decked boats were introduced to begin small-scale commercial operations. Brazil's artisanal fleet still includes fishermen operating from small canoes with no holds or method of safeguarding the quality of the catch. These vessels go out and return to port daily. The artisanal fleet now includes increasing numbers of also includes decked boats which are in fact engaging in small-scale commercial fishing.

Gear: The artisanal fishermen deploy a wide variety of gear, but set nets and lines, weirs, traps, hand lines, longlines, gillnets/driftnets, and troll gear are the most common. Most of the longlines deployed by the artisanal fishermen have been demersal longlines.

Modern monofilament driftnets have become increasingly used by the fishermen in the 1990s.

The massive artisanal fleet targets an extremely wide variety of species, as in often the case in tropical waters. Brazil has an especially great diversity of species because of the long coastline extending into both tropical and temperate latitudes. The species targeted by the artisanal fishermen are primarily demersal, but include some pelagic species as well. Current details on the species composition, however, are unavailable as the Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis (IBAMA) decided in 1991 that it had to discontinue data collection because of the high cost of collecting information from the artisanal fishermen.[290]

The species available off Brazil in general lend themselves to small-scale operations. There are no large stocks of groundfish with large single-species schools, like those existing further south off Argentina, that can be harvested by large-scale commercial trawling. Nor is the fishery dominated by small pelagic species like those off Chile and Peru which can be efficiently harvested by commercial purse seiners.[291] Thus small-scale operations based on multiple-species methods have proven most suitable approach for Brazilian conditions.

Brazil's large artisanal fishery plays a major role in supplying edible fish to the country's domestic market. The importance of the artisanal fishermen vary by region, but supplies as much as 90 percent of the fresh and frozen seafood sold in some region. Much of the small-scale catch using lines and small nets, especially the catch taken by small canoes and other undecked craft, is sold on the beach or in local markets. The quality of the catch produced by the fishermen limits marketing, especially the catch landed in remote villages. The larger artisanal vessels land product that is marketed throughout the country.

The limited range of the small vessels deployed has meant that the artisanal fishermen have focused primarily on demersal resources and therefore have take few large pelagics. It also means that they have had to concentrate their effort on close-in coastal resources. Thus the demersal stocks traditionally fished have become badly depleted. Many artisanal fishermen report falling catches and minimal returns with the demersal gear that they have been using. As a result, many of the fishermen have in recent years shown an increasing interest in diversifying their operations to pelagic species

Photo 68.--Artisanal fishermen have for years taken a few sharks, billfish, and related species like sawfish. Modern gear and methods, however, are increasing pressure on these resources.

The artisanal fishermen do not normally take significant quantities of large pelagics. Some species of interest taken by the artisanal fishermen include:

Sharks: Artisanal fishermen since the 1960s deploying both demersal longlines and gillnets have been taking substantial quantities of sharks. The fishery focused on inshore demersal species such as narrow-nose smooth hounds (*Mustelus schmitti*). This was an important development because the fishermen succeed in developing a local market for shark which the commercial longliners in the 1970s were to take advantage of to market their incidental shark bycatch. Elsewhere in Latin America, at the time, sharks were not being targeted or consumed widely and there was little domestic demand. The artisanal fishermen continue to heavily target sharks. Prices for shark are comparable to other demersal species. They report notable catches of a variety of shark species. The fishermen were initially selective as to what species they would retain and would discard dogfish and other small sharks (*Heptranchias* and *Squalus spp.*). When large numbers of hammerheads were taken, many fishermen would simply fin them and discard the carcasses. This practice still occurs in some drift net fisheries, but overall catches have declined to the point that the fishermen retain almost all sharks. The only species generally discarded now is the six-gill shark, but catches of that species are small.[292]

Tunas: The bulk of the country's catch of tuna is taken by the commercial fleet, but the artisanal fleet is not insignificant. Government officials estimated that in 1984, over 20 percent of the tuna catch was landed by artisanal fishermen.[293] This has declined in recent years, however, as the country's commercial tuna longline fishery has developed. Most of the artisanal catch of tuna-like species consists of tuna-like king mackerel(*Scomberomorus* cavalla) and Spanish mackerel (*S. brasiliensis*).[294]

Brazilian artisanal fishermen in the 1990s are adopting improved gear and techniques that are enabling them to target some large pelagics. The introduction of monofilament gillnets has greatly increased shark catches and even billfish. The traditional artisanal fishery, despite is large size, does not appear to catch significant quantities of swordfish. Unlike sharks and some billfish like sailfish, swordfish do not commonly approach the coast where most of the artisanal fishermen with their small boats focus their fishing effort.

Experiments with artisanal longlining suggest that the artisanal fishermen may in future years begin to target swordfish using monofilament longline. Some artisanal fishermen have already deployed small longlines and targeted swordfish and the results are encouraging. Some local observers believe that this new artisanal fishery could play an increasingly important future role in the country's developing swordfish fishery. (See: "Artisanal longlines".)

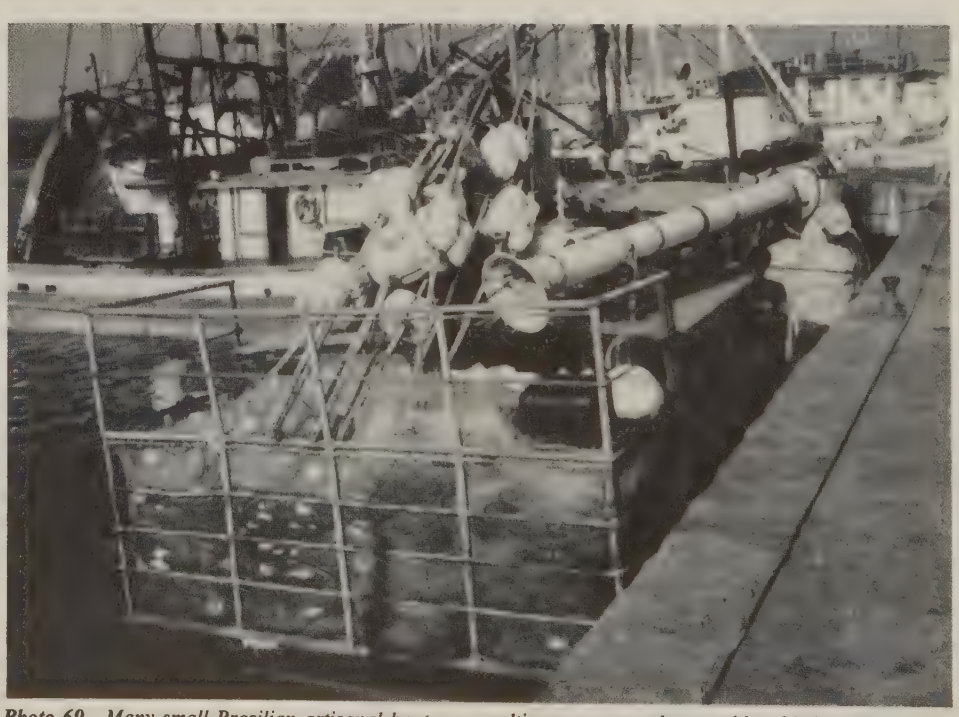


Photo 69.--Many small Brazilian artisanal boats are multi-purpose vessels, capable of being deployed in several different fisheries. D. Weidner

Photo 70.--Artisanal monofilament gillnets have significantly increased the capability of many artisanal fishermen. Fishing effort on sharks in particular has increased. D. Weidner

2. Monofilament gillnets

Traditional artisanal fishermen began to take sharks with lines and gillnets during the 1960s. This fishery helped to create a market for shark in Brazil that commercial longline fishermen were able to take advantage of beginning in the 1970s.[295]

Artisanal fishermen in the 1990s have begun deploying more efficient monofilament gillnets. Many of these fishermen could be classified as small-scale commercial fishermen. Sharks are an important target species for them. Such fishermen are especially active in Rio Grande (RGS), Itajaí (SC), Santos (SP), and Natal (RGN), but there is similar activity at many other ports. The Rio Grande fishermen, for example, began to deploy gillnets in 1990. About 25 small wooden boats (approximately 15 m) deployed gillnets from Rio Grande in 1996. The nets are about 10 km long and use 14 cm mesh (stretched measure). They primarily target soupfin shark, but also take quite a few smooth dogfish. Similar activity is reported at several other Brazilian ports.

Artisanal fishermen since the 1960s have succeeded in developing a strong market for sharks in Brazil. Shark is a popular species in Brazil. It is common to see shark products at Brazilian fishery markets. Seafood markets will often have a shark trunk on display with swordfish and tuna and the customer can specify the quantity he wants carved off the trunk. these trunks are often to large to fit into protective display cases and are placed on top of them.

The demand has given rise to directed fisheries for sharks. The result has been increasing fishing effort, especially for the coastal demersal species that are most accessible to the artisanal fishermen. The efficiency of the monofilament gillnets has greatly increased fishing pressure on the inshore demersal sharks. Several species are reportedly being overfished.[296] The gillnet fishermen with the monofilament gillnets also appear to have begun taking substantial numbers of billfish--especially sailfish. While a small part of the fishermen's catch, the expanding gillnet fishery is increasing pressure on sailfish (appendices E4b4-5).[297]

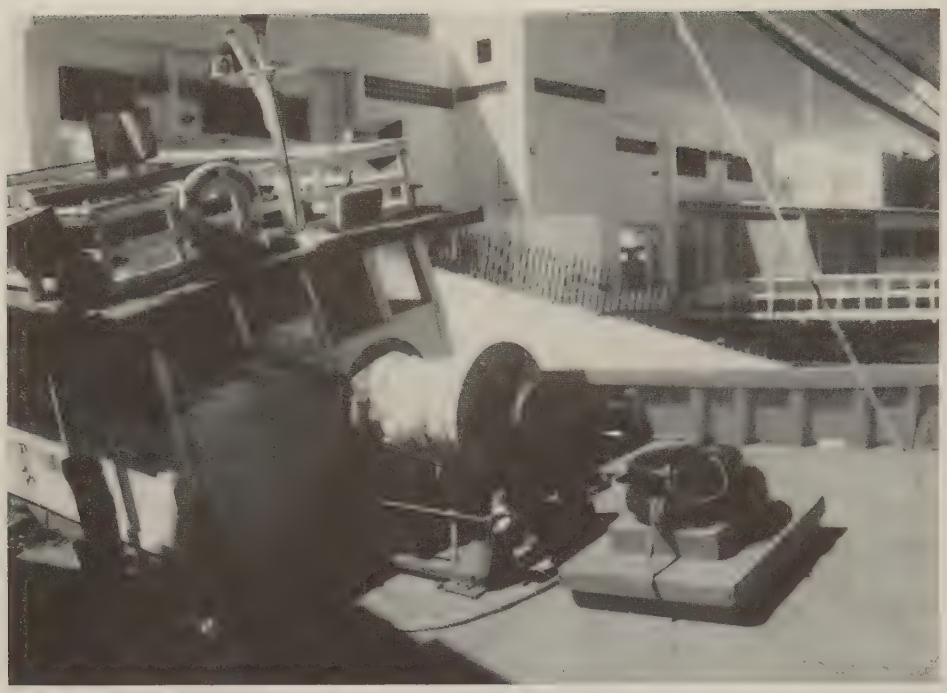


Photo 71.--The artisanal fishermen experimenting with pelagic longlines are deploying 10-15 km mainlines. The small initial investments are reportedly achieving excellent returns. D. Weidner

fishery could help expand the Brazilian pelagic catch without the significant capital investments associated with launching a commercial fishery. An artisan pelagic fishery would also create jobs in a badly depleted sector as well in isolated coastal villages where job opportunities are very limited.

The principal gear and methods used in the Brazilian pelagic longline fishery have been Japanese multi-filament operations. These methods were never successfully transferred to the artisanal fishermen. The labor intensive Japanese methods are really not suitable for small vessels with limited crews. Some of the Brazilian longline vessels have been as small as 16 meters. While many of the Brazilian vessels might be classified as artisanal, the authors have addressed them within the commercial section of this chapter. The gear and methods were never successfully adapted for operations by Brazil's large fleet of small, multi-

3. Monofilament longlines

a. Pelagic

Various efforts have been reported to adapt pelagic longline techniques and gear to the artisanal fishery. Many artisanal fishermen report declining yields and falling income. A new fishery to reduce effort on heavily fished coastal demersal species would be highly beneficial to the fishermen. The small initial investments in an artisanal vessel also have substantial potential economic advantages over the very great cost of building a commercial vessel or even re-rigging an older commercial vessel.

From Brazil's perspective there would be a number of advantages associated with launching an artisanal fishery targeting oceanic pelagics. A successful artisanal

Photo 72.--This is one of the small artisanal boats that is deploying small monofilament longlines along the northeastern coast out of Natal in 1998. D. Weidner

Photo 73.--Small longline drums like these are being installed on artisanal boats in Brazil. This one is being used by UFRPe for research on longline gear and methods. D. Weidner

purpose vessels. Since the mid-1990s the commercial fishermen have shifted away from the Japanese multi-filament gear to the U.S. monofilament. There is some evidence that the monofilament gear may be more easily transferable to small boat, artisanal operations.

Researchers at the Universidade Federal Rural de Pernambuco (UFRPe), in cooperation with a fishing company (Norte Pesca), adapted gear used by American longliners to the small boat artisanal fishery. Preliminary work suggests that innovations of United States-style fishing (monofilament, squid bait, and light sticks) have the potential to greatly increase the income of artisanal fishermen using boats of about 12 meters. This would potentially open the pelagic longline fishery up to a very large number of artisanal vessels. The vessels currently being tested are equipped with ice holds. The vessels have a range of about 100 nautical miles and normally work on the shelf out to the 100-m isobath. They usually limit their trips to a maximum of about 6 days. The fishermen normally make about 5 sets per trip. The vessels carry crews of about six fishermen. Operations are not mechanized, except for the line hauler winch. They deploy mainlines of about 10-15 km, normally with about 300 hooks. Information on the set depths is unavailable. The fishermen are primarily targeting swordfish, which in these operations makes up about half the catch. Trials conducted in 1997-98 showed that these vessels take about 70 fish per trip totaling 2.2 tons. About half the catch is swordfish (appendix D4a2). The remainder is tunas (30 percent), sharks (15 percent), and other species (5 percent). While swordfish was the major species taken, the artisanal catch was much more varied than that reported by the commercial fishermen (appendix D4a1). In particular the artisanal fishermen reported larger tuna catches, especially bigeye catches (appendix D4a2).[298]

The earnings/cost ratio of the artisanal operations appears highly favorable. The UFRPe estimates earnings of almost R6,000 ($5,600) per artisanal trip. The costs associated with a trip are only about R2,250. The major operating costs for the artisanal fishermen are food, bait, and light sticks (appendix D4b2).

Notably the fuel costs are much less than for the commercial longliners (appendix D4b1). This is a major concern in a country which imports oil. The international oil price is currently at record low levels in real terms. Such low oil prices are not likely to continue indefinitely. Future major increases in oil prices could significantly impact the operating costs of companies operating large commercial vessels. Thus energy-efficient operations are of considerable interest in Brazil.

Operating costs for the artisanal fishermen (appendix D4b2) or a small fraction of the costs associated with a commercial trip (appendices D4b1-2). Of course the catch is proportionately less. The operating cost of a artisanal vessel is about 10 percent of a large commercial vessel, but the catch is only about 10 percent of the commercial vessel (appendices D4a1-2). Despite the apparent similarity in results, there are some real advantages to the artisanal operations if the results of the initial UFRPe study are confirmed by actual operations:

Limited investment: The small initial capital investment needed for an artisanal vessel mean that many Brazilians could potentially enter the fishery.

Vessel maintenance: The small artisanal vessels are easier and less costly to maintain than the commercial vessels.

Job creation: An artisanal operation would create good paying jobs for poverty stricken Brazilian artisanal fishermen in numerous isolated villages with virtually no job opportunities.
Product quality: The limited range of the vessel means short trips which would result in a fresher, better quality product. Of course there are a variety of quality control issues associated with artisanal fisheries, so the quality of product the artisanal fishermen actually produce remains to be seen.

There are some advantages to the commercial operations that the new artisanal fishery can not match. One of the most important is the extensive range of the larger vessels. The artisanal vessels are limited to coastal waters while the commercial vessels with greater autonomy have more flexibility in seeking productive fishing grounds. In addition, the larger more stable vessels can operate in weather conditions which would force the small artisanal vessels into port for shelter.

Norte Pesca handles the marketing of the catch. Only three vessels were active in early 1998, all of which operated out of Natal. A fourth boat joined the fleet in May 1998 and was deployed out of a small fishing village 120 km south of Recife. UFRPe researchers believe that the new methods could rapidly spread among the fishermen because of the very profitable results being reported by the initial vessels in late 1997 and early 1998.[299]

Photo 74.--This artisanal Brazilian fisherman is boating a swordfish. He is operating his boat as part of a UFRPe study. João Wanderley

UFRPe researchers, in addition to operational trials, have contracted with an artisanal fisherman at São José, a fishing village south of Recife, to do test fishing under carefully controlled conditions. Initial results from these trials are achieving favorable returns. Preliminary results indicate that sets average about 8.3 fish per 100 hooks. The fish taken include swordfish, sharks, tunas, billfish and a variety of other species. A breakdown by species is not yet available.[300] A Brazilian investor was sufficiently impressed to purchase five 15-m fiberglass boats equipped with winches and capable of deploying 500-600 hooks. The owner plans to target swordfish.[301]

Photo 75.--Longline drum and winch of a bottom longliner operating off Santa Catarina state. Fábio Olmos

b. Demersal

A variety of Brazilian fisheries take species also taken by the pelagic longline fishermen or report interactions with species discussed in the bycatch chapter. These fisheries are mostly artisanal or small commercial operations. In a few cases larger vessels may be involved. One of the most important is a demersal longline fishery. The fishery is essentially artisanal, but could also be described as small-scale commercial fishing.

Brazilian fishermen are expanding their longline operations which now include demersal operations. The demersal longliners take a variety of species, including tilefish (*Lopholatilus villarii*), namorando (*Pseudopercis numida*), groupers (*Epinephelus spp.*), and various sharks. The fishery is primarily, but not exclusively, coastal. One report indicates fishing as far as 150-320 km off Parana and Sao Paulo States, as well as southern Brazil.[302] Demersal longlining is also conducted off Santa Catarina. There is no swordfish bycatch as a result of their largely inshore operations. There are, however, interactions with seabirds. (See "Bycatch.")

As the focus of this report is the pelagic longline fishery for swordfish, the authors have not pursued the subject of Brazil's demersal longline fishery. While the swordfish take is apparently limited, the shark catch is substantial and there appears to be significant interaction with seabirds. (See "Bycatch".) While this assessment of the swordfish fishery does not pursue the demersal longline fishery, any overall assessment of the Brazilian longline fishery will need to address the demersal fishery.

Photo 76.--These Brazilian fishermen are hauling in a bottom longline off São Paulo state. Fábio Olmos

Photo 77.--These fishermen off Santa Catarina are setting a bottom longline. There is no swordfish bycatch, but sharks are taken. Fábio Olmos

C. Recreational fishery

The Brazilian marine sport fishery for billfish is primarily centered along the three south central states of Espírito Santo, Rio de Janeiro, and São Paulo.[303] Most tournaments are conducted out of marinas in these states. Most of the available charter boats are available in this area, especially in São Paulo state.[304] These states encompass the massive urban areas of São Paulo and Rio. These two cities are the two largest and wealthiest in Brazil. This in part explains why the sports fishery is concentrated is these areas. It is here that large numbers of affluent Brazilians live who have the money and propensity to pursue sport fishing. There are, however, tournaments in other areas of Brazil. One of the most important is the Torneio de las Americas conducted from Salvador in Bahia state.[305]

There are about 50 fishing clubs at various cities all along the Brazilian coast and at several interior sites.[306] Four large clubs in Brazil are especially active with billfish sport fisheries. The IATE Rio de Janeiro Yacht Club has the most active big game recreational fishing program, but fishing is also popular at Ilhabela[307] (São Sebastião), Santos, Cabo Frio, and Vitória. There are many more yacht clubs in Brazil. Virtually every sizeable coastal city has a yacht club, but they vary greatly in their participation in sports fishing. Besides the Rio de Janeiro Yacht Club, clubs are actively pursuing billfish at Bahia São Vincente and Ilhabela.

Photo 78.--Most of the Brazilian billfish and swordfish catch is taken by commercial and artisanal fishermen, recreational catches are minor. D Weidner

The Brazilian sport fishing tournaments focus on billfish (primarily sailfish, but also blue and to a lesser extent white marlin) and tunas. The relative abundance of these different billfish species has varied substantially since the 1970s (E4b appendix series). Some of the best catches are reported at Ilhabela, an island close to the coast. Billfish are especially abundant off Ilhabela.[308] Brazilian sport fishermen reported some notable catches of white marlin and yellowfin tunas in 1996-97 from Rio de Janeiro and Guarapari, as well as a Grand Slam (sailfish, white marlin, and blue marlin) out of Vitória (Venezuela, appendix D8b).[309] One company operating out of Vitória offers blue and white marlin fishing, reporting good white marlin fishing from November through January and good blue marlin fishing from December to February.[310] A typical sport fishing trip out of the marinas in Brazil's southeastern states starts in the morning. It takes about 3 hours to get to the best fishing grounds, a distance of 100 km depending on which marina is

Photo 79.--The billfish sport fishery is centered in the Rio/São Paulo area. This is an advertising poster for a billfish tournament sponsored by the Ilhabella (Beautiful Island) Yacht Club.

selected. Boats from Ilhabela can fish off Ilha Sumítica, about 65 km from the Yacht Club, but the best fishing is reported in an area referred to as "Teta", about 110 km from the Yacht Club.[311] The boats generally run at about 20 knots. There are some smaller boats which can only run at about 10 knots. The captain looks for water temperatures from 20°-25°C and depths of 100-200 meters. Boats are equipped with satellite navigational systems and computers which can print out sea-surface temperature readings to help find the best places to fish. The gear generally is capable of trolling a line up to 500 meters. The primary billfish taken is sailfish and it can take anywhere from 15 minutes to several hours to boat one.[312]

The yacht and sport fishing clubs along the southeastern coast sponsor several tournaments, primarily during the October to January period when billfish fishing is at its peak. This would be the summer season in the southern hemisphere off Brazil. Seasonality varies somewhat for the different species: sailfish (December) and blue marlin (October-December). White marlins have reportedly not been taken in numbers by the sport fishermen during recent years.[313] One report from Ilhabela describes tournaments beginning in the 1970s, but there were probably earlier tournaments held in other more established ports. The larger tournaments have generally had 20-40 participants. Almost all of those participants are Brazilians with only occasional foreign participation.[314] One U.S. sport fishing operation (Artmarina) in 1998 operated charter boats north of Vitória and has succeeded in attracting some U.S. anglers to Brazil.

ICCAT reports that voluntary catch and release fishing has become increasingly common.[315] One Instituto de Pesca (IP) researcher in Santos indicates that he and his staff have worked hard to promote catch and release programs and that they have achieved considerable success.[316] Few Brazilian sport fishermen actually eat billfish. A few want trophies, but most have been quite happy to participate in the catch and release program. The IP is conducting a tagging program. (See "Research.") One observer estimates that over 75 percent of the billfish taken are now tagged and released.[317] While important, Brazil's catch and release efforts will have little real impact. The sport fishing catch is largely unknown, but ICCAT estimates that it has never exceeded 40 t (appendix E4b4). This is probably a high estimate. Domestic and foreign fishermen, however, took over 700 t of billfish (excluding swordfish) in 1996 (appendix E4b3). Catches of these magnitudes render ineffectual the commendable efforts made by the sport fishermen to responsibly utilize the billfish resource. Even so, the catch and release program should not be dismissed as meaningless. It is helping to build an environmental ethic which may prove critical if and when the Brazilian Government addresses the question of billfish management.

Brazilian groups have done some work with fish aggregating devices (FADs) to attract billfish.

1994: The Ilhabela Yacht Club deployed FADs in 1994 (30 units, 10 kites of McIntosh FADs) to attract billfish for sport fishing. The units in 1996 were reportedly working well and significantly improved blue marlin and sailfish strikes in the big game fishery.[318]

1999: A Brazilian group currently is working on another FAD project, CULTIMARES. The group includes government agencies (the Instituto de Pesca), academia (University of São Paulo), sport fishermen (Ilhabela Yacht Club), and fishing companies are working with U.S. consultants, McIntosh Marine Inc.

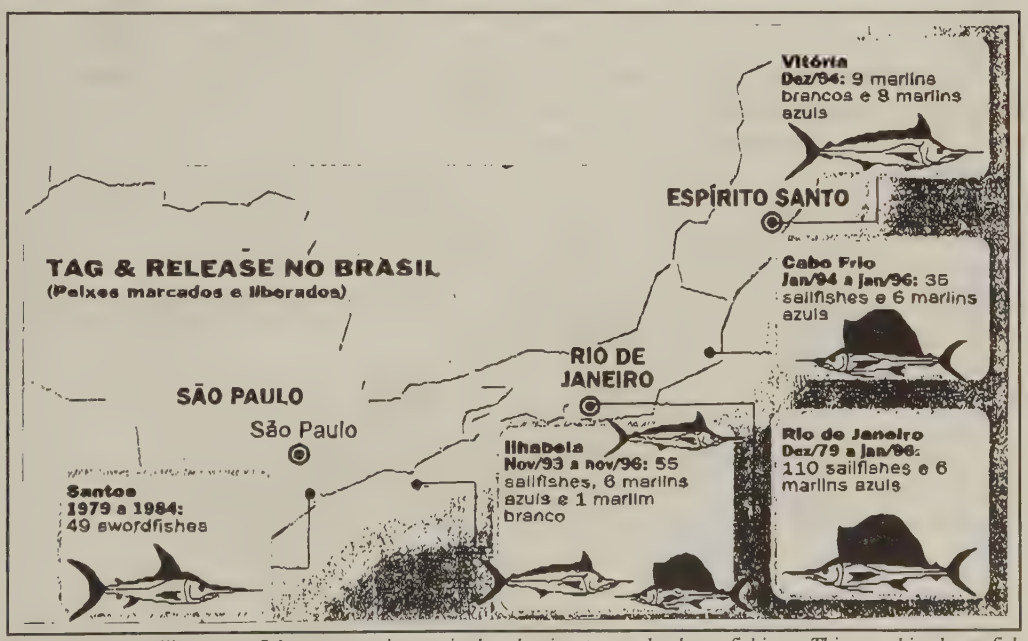


Figure 61.--Brazilian sport fishermen are increasingly adopting tag and release fishing. This graphic shows fish tagged and released along the southeastern coast.

Petrobras, the giant state petroleum company, is providing logistical support and may assist in monitoring efforts after the FADs are placed.[319] The CULTIMARES group has prepared a plan and it hopes to actually install FADs in the Santos area during 1999. The new McIntosh FADs will be primarily Mostkoff Tetrahedron benthic-structured and will be placed in more inshore areas than the FADs installed in 1994 to assist artisanal fishermen targeting demersal species. A few new FADs will also be placed in offshore areas designed to improve billfish catches for the sports fishermen.[320]

The authors know of no recreational fishing for swordfish in Brazil. Notably on the long list of sport fishing records maintained by the Confederaço Brasileira de Pesca e Desportos Subaquáticos (CBPDS), swordfish is not even listed.[321] One 61-kg swordfish was taken in February 1996, by a recreational fisherman off Brazil.[322] This was an unusual strike, however, and the only swordfish the authors have noted in reports by recreational fishermen. Species like sailfish have a much more coastal range than swordfish and are thus more available to sport fishermen. There are, however, some committed devotees to the challenge of boating a swordfish and thus it has some potential to be developed as part of Brazil's sports fishing industry.

The Brazilian recreational billfish fishery has been described as "nascent". The freshwater sport fishery for species like peacock bass seem much better publicized than billfish fisheries in Brazil. While Brazil's recreational fishery, especially for billfish, is still small by U.S. standards, many of the available facilities are excellent.

Sports fishermen in Brazil do not seem to be fully utilizing the country's potential resource of big-game fish. The vast proportion of the billfish catch off Brazil is being taken in commercial and recreational fisheries. The recreational fishermen have not yet succeeded in getting regulations approved limiting billfish takes in the commercial longline fishery. In addition, expanding artisanal gillnet fishing appears to be taking increasing numbers of billfish, primarily sailfish (appendix E4b4).

Given the quantity of billfish being harvested by commercial longline and artisanal gillnet fishermen, there is clearly a substantial resource off Brazil. The recreational fishery has the potential to significantly expand. A management regime limiting commercial and artisanal catches and allocating only a small share of the resource for sport fishermen could still permit a major expansion of the recreational fishery far beyond its current size. Even without a management regime, the recreational fishery could be substantially expanded with little impact on the resource. Fishing effort is largely determined by the commercial and artisanal fishermen.

The economic impact of the fish now being harvested by commercial and recreational fishermen would be increased many times over if taken as part of a recreational fishery. Some Brazilian observers have seen the economic impact of sport fishing in the United States and other countries and are projecting the potential impact of an expanded Brazilian sport fishery.[323] For some reason, foreign anglers have not participated in the Brazilian fishery to the extent they have in many other foreign fisheries. U.S. sport fishing groups like the Billfish Foundation, however, are interested in expanding their contacts with Brazilian sports fishing groups.

VII. Catch and Effort

Brazil has been the principal Latin American country fishing south Atlantic swordfish. This is primarily because of substantial swordfish resources available along the country's lengthy coast. It is also because of the fisheries background of the country's Japanese immigrant population. Many Japanese immigrants in the 1950s and 1960s had fisheries experience and technical training. They played an important role in the development of Brazil's commercial fishing industry out of all proportion to the number of individuals involved. The Japanese-Brazilians, for example, played a major role in establishing a domestic longline fishery. The fishery they developed was a multi-species fishery targeting tunas and other oceanic pelagics like swordfish. The species composition varies, but swordfish in some years was only a minor part of the catch.

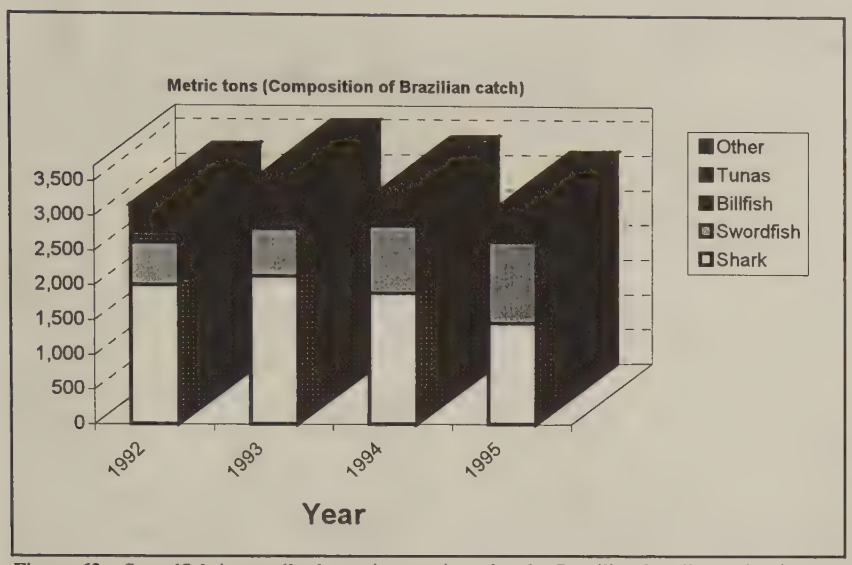


Figure 62.--Swordfish is usually the major species taken by Brazilian longliners, but in some years large quantities of other species are taken.

Swordfish catches in the south Atlantic have reached record levels and currently exceed the quantities taken in either the north Atlantic or Mediterranean (appendix E3a4). The Atlantic swordfish fishery has been centered in the north Atlantic since the fishery was initiated in the late 19th century with harpoons. Until recently most of the fish was taken in either the north Atlantic or Mediterranean with much smaller quantities taken in the south Atlantic. Much of the small south Atlantic catch was taken primarily by Japanese fishermen (appendix E3a1). The situation changed markedly in 1987-88 when Spanish fishermen, responding to ICCAT north Atlantic catch restrictions, shifted operations into the then unregulated south Atlantic.[324] As a result, the south Atlantic catch exceeded that of the north Atlantic and Mediterranean for the first time in 1990 (appendix E3a4).

While Brazil is the principal Latin American coastal country pursuing the swordfish longline fishery in the south Atlantic (south of 5°N), it is not the most important fishing country. Distant-water Asian countries initiated the fishery in the 1960s and dominated it through the mid-1980s. The principal countries involved were Japan, Korea, and Taiwan (appendix E3a1).[325] These three countries from 1965 to 1987 accounted for over 60 percent of the total south Atlantic swordfish catch, which rarely exceeded 5,000 t annually. Brazil and the other coastal Latin American countries took only about 20 percent of the catch over this same period.[326]

The south Atlantic swordfish situation changed dramatically in 1987 when ICCAT, responding to the steadily escalating effort on north Atlantic swordfish,

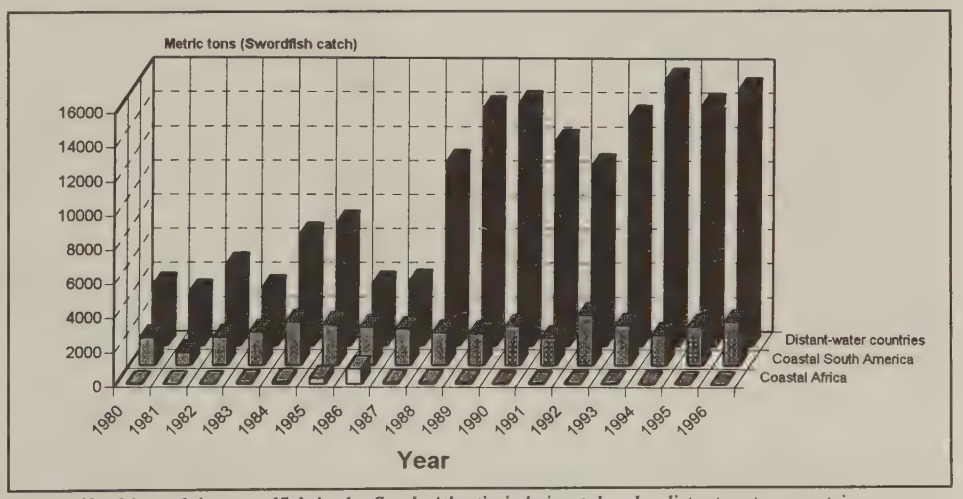


Figure 63.--Most of the swordfish in the South Atlantic is being taken by distant-water countries.

approved a management recommendation limiting effort through quotas. This caused a substantial shift of Spanish effort to the south Atlantic (appendices E3a1-2).[327] This has significantly altered the south Atlantic swordfish fishery.

Quantity: The quantity of swordfish harvested has increased dramatically. South Atlantic harvests have more than tripled, increasing from 6,000 t in 1987 to a record 20,600 t in 1995 (appendix E3a4). ICCAT instituted a "cap" beginning in 1995 to try to limit the expanding south Atlantic fishery (appendix E3a8). While the 1995 catch actually increased to the record 20,600 t, the 1996 catch did decline somewhat to 18,000 t--although this is only a preliminary estimate. Notably, the substantial 1994-96 harvests of 17,400-20,600 t are comparable to the peak harvests in the north Atlantic fishery (appendix E3a4).

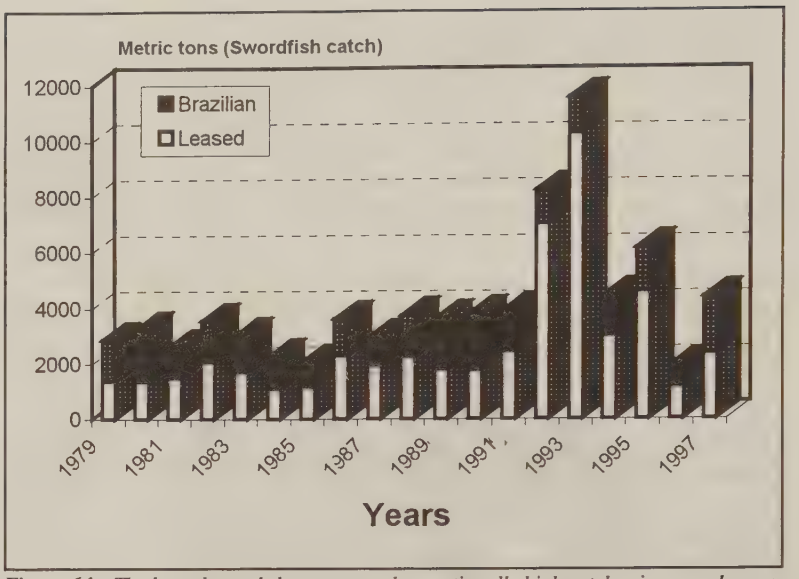


Figure 64.--The leased vessels have reported exceptionally high catches in several years.

Grounds: Initially the south Atlantic swordfish fishery was primarily focused on the southeastern Atlantic off Africa. Much of the initial Spanish catch increases (1988-89), for example, were in the southeastern Atlantic. Subsequent catch increases, however, have been in the southwestern Atlantic closer to the South American (Brazilian/Uruguayan) coast (appendices E3a1-2). The overall catches taken in the southwestern Atlantic (FAO area 41) exceeded those taken in the southestern Atlantic for the first time in 1992 (appendix E3a3). Since then the catch in the southwestern Atlantic has been about half (46-57 percent) of the total south Atlantic catch, although it declined to 43 percent in 1996.

Distribution: The distribution of the swordfish catch has shifted. Most of the south Atlantic swordfish catch is now taken by Spanish fishermen. The Spanish in 1996, for example, took over 54 percent of the south Atlantic catch. The catch of the Asian countries after 1988 has fallen to only about 28 percent. The Brazilian share of the south Atlantic catch, however, has increased above the 10 percent level that it had averaged for many years (appendix E3a9).[328]

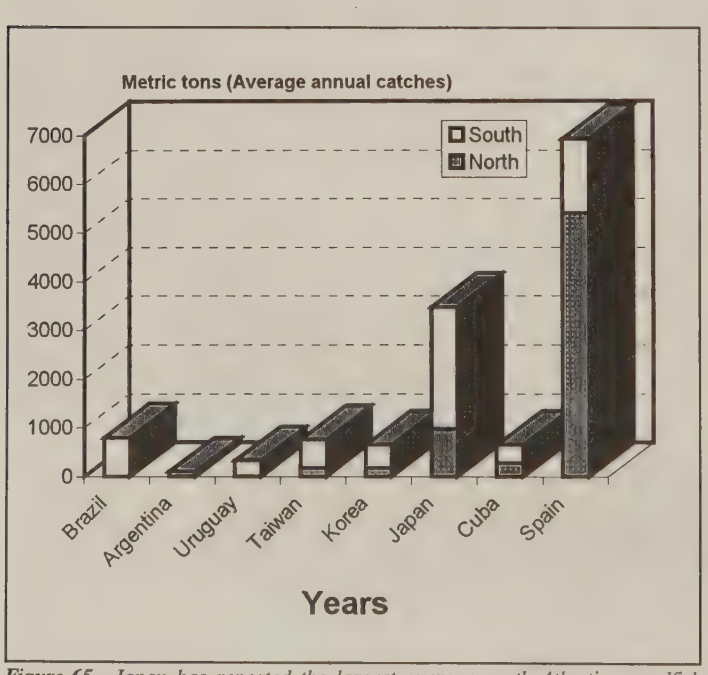


Figure 65.--Japan has reported the largest average south Atlantic swordfish catch during 1970-93.

The two commercial longline fleets (Brazilian and leased foreign vessels) target a variety of species. Tuna has been the primary target species, but important quantities of swordfish and sharks have also been landed.[329] The species composition of the two fleets varies somewhat, depending on the methods, grounds, and target species. Swordfish is important to both fleets, but especially to the domestic Brazilian fleet.

Brazilian vessels: The Brazilian longline fishery has been a multiple species fishery targeting tunas (bigeye, yellowfin, and albacore), swordfish, and shark.[330] A few other species such as billfish, oilfish, opahs and wahoo are also taken. The most important species are swordfish and to a lesser extent yellowfin. More than half of the catch in one year (1980) was swordfish and the species have regularly been

Photo 80.--Much of Brazil's longline catch is landed at Santos. Here Brazilian longline crew members are preparing to unload the hold. Dennis Weidner

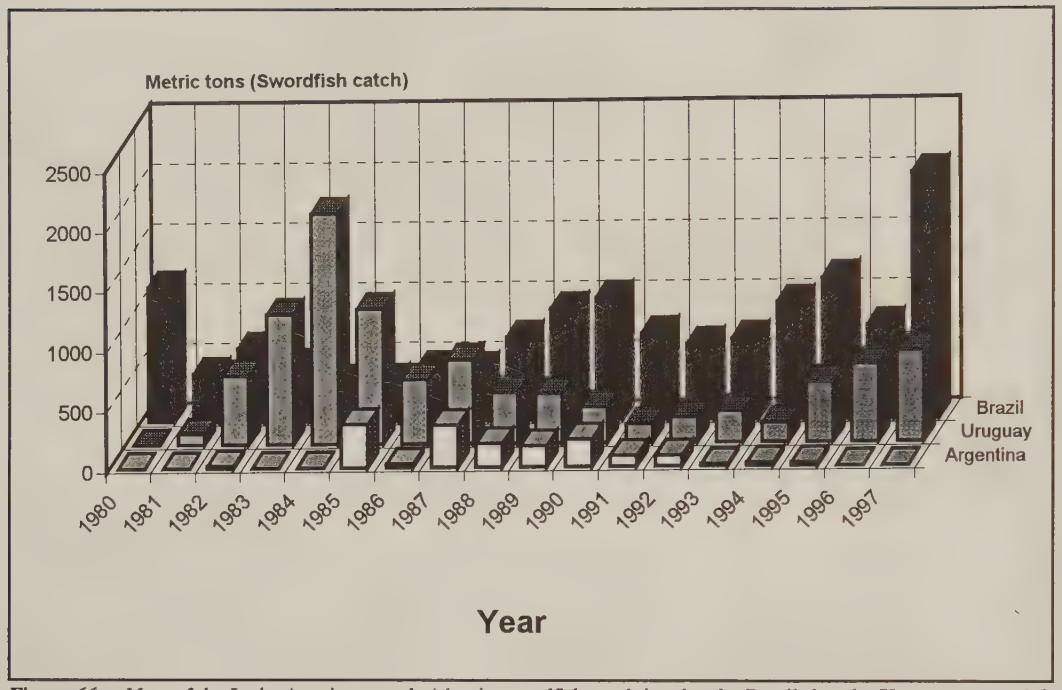


Figure 66.-- Most of the Latin American south Atlantic swordfish catch is taken by Brazil, but the Uruguayan catch is increasing.

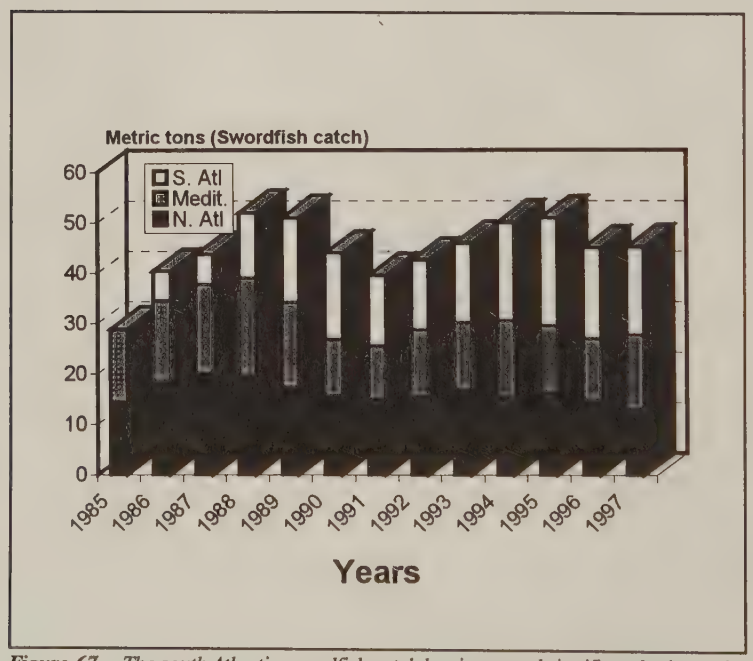


Figure 67.-- The south Atlantic swordfish catch has increased significantly since mid-1980, accounting for all the expansion of the Atlantic swordfish findings.

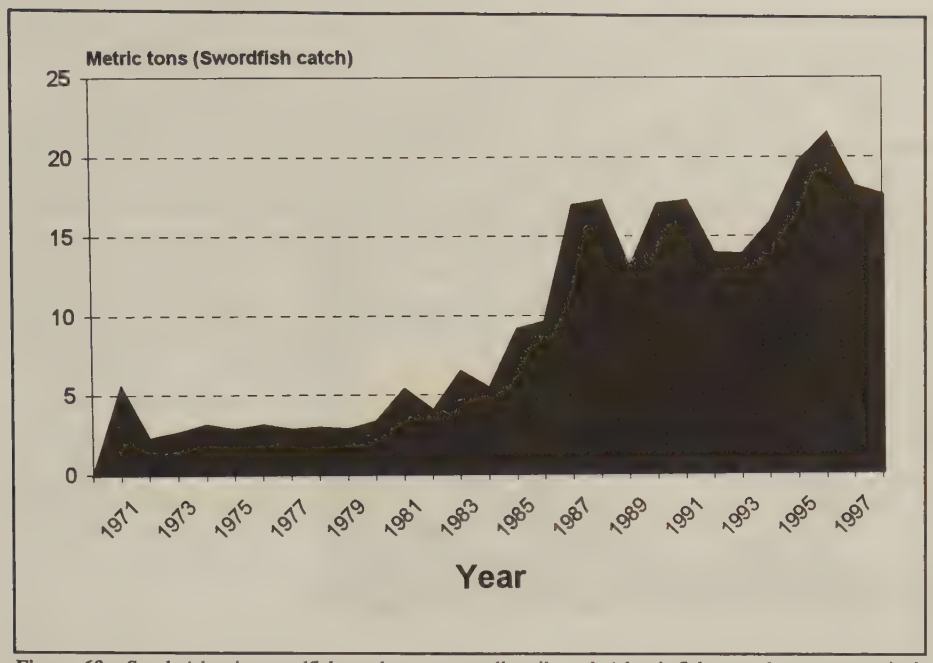


Figure 68.--South Atlantic swordfish catches were small until north Atlantic fishermen began to massively shift effort south in the late 1980s.

about a third of the catch (appendices D2b and E3b1b). Tuna catches (especially) albacore and bigeye have declined since 1984, primarily because of increasing effort on sharks.[331] Sharks are a major part of the Brazilian longline catch (appendix E4c1), although some Brazilian data sets exclude sharks in their calculations of catch composition. Yellowfin catches, however, have not declined because fishing effort along the northeast coast, where yellowfin are abundant, has expanded. Changes in fishing methods have resulted in increasing effort on swordfish in the 1990s. As a result, the swordfish proportion of the catch has increased and totaled over 65 percent in 1994 (appendix E3b1b).[332]

Leased foreign vessels: The fishery was initiated by leased Japanese vessels which first targeted yellowfin and then shifted to albacore. The Japanese fishermen during the mid-1980s shifted again to bigeye. Currently the foreign fishermen continue to catch primarily tunas (especially bigeye) (appendix D1c). Taiwan fishermen often target albacore. Swordfish is, however, also important. Even so, the swordfish proportion of the foreign-leased catch rarely exceeds 25 percent and has usually been much less (appendix E3b1b). Smaller quantities of billfish are also taken.[333] Since the first few years of the fishery, swordfish has ranged from about 13 percent (1977) to 38 percent (1990) (appendix E3b1b). The Japanese reported from 1977-89 that nearly 15 percent of their catch was swordfish, mostly taken on the southern grounds south of 25°S (appendix E3b3b). There is also a substantial bycatch of species of limited or no importance. (See "Bycatch.") The operations of the Taiwan vessels leased since 1991 are somewhat different, targeting albacore more heavily than the other tunas. Preliminary data suggest that the swordfish catch of the Taiwan vessels is also larger than reported by the Japanese in most years. Beginning in the mid-1990s, expanding activity has been reported by the leased vessels off northeastern Brazil.[334]

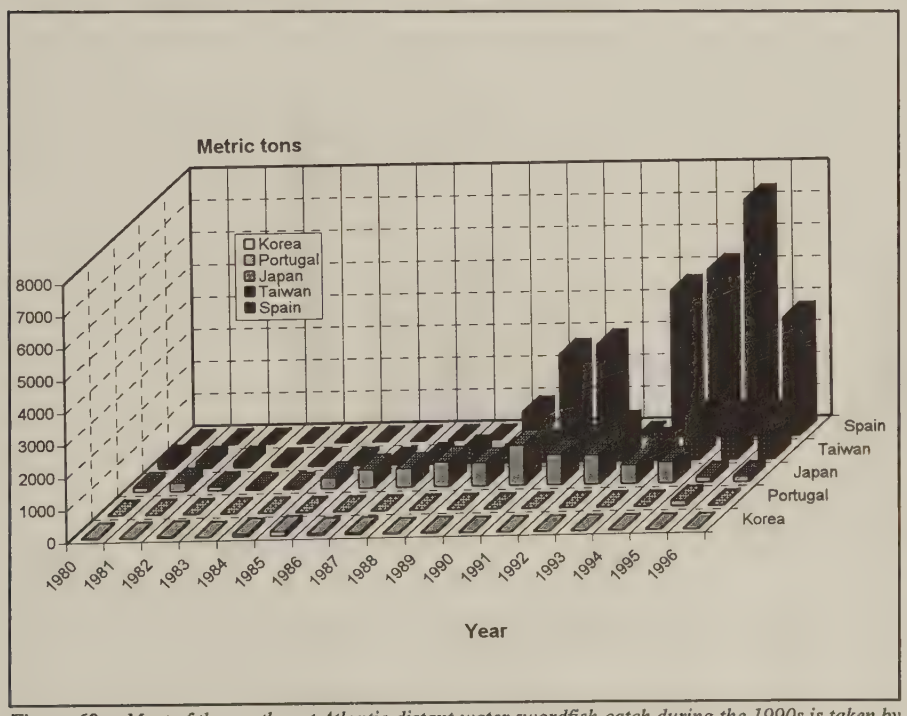


Figure 69.-- Most of the southwest Atlantic distant-water swordfish catch during the 1990s is taken by Spanish fishermen.

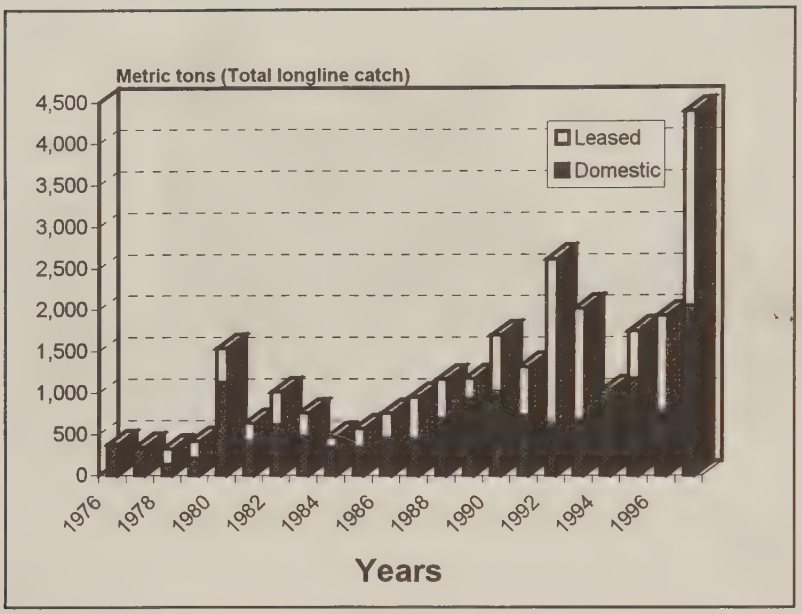


Figure 70.-- While the domestic Brazilian fleet generally takes more swordfish, the foreign leased fleet lands much larger quantities of other species.

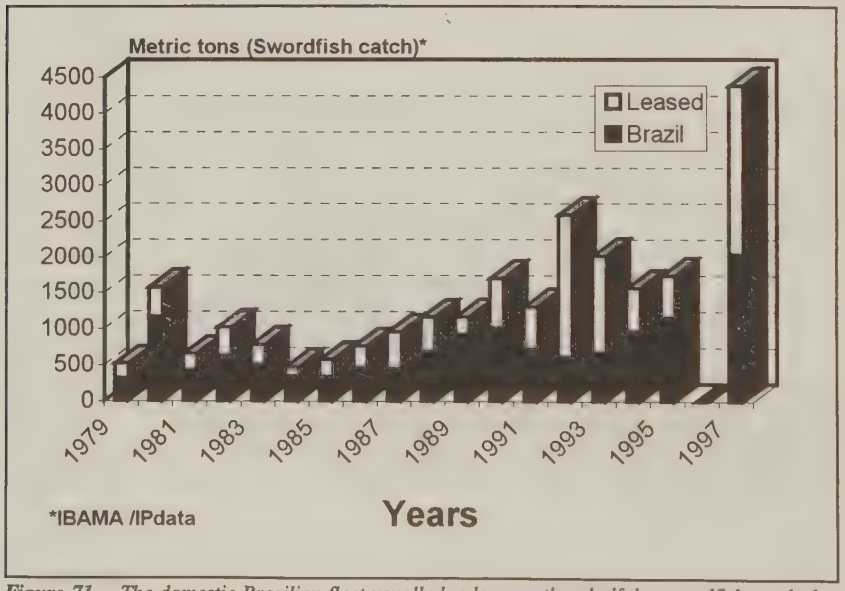


Figure 71.-- The domestic Brazilian fleet usually lands more than half the swordfish catch, but the leased fleet is also important.

A. Effort

The authors do not have adequate data to access longline fishing effort, either of the domestic or foreign leased fleets. Some historical data and some more recent but incomplete data sets are collected in the D2 series of appendices. No trends can be delineated from the incomplete available data. The most complete data set is that compiled by the Japanese (appendix D2f), but their vessels now represent only a small part of the foreign fleet. While data is unavailable for any definitive assessment, the shift of Brazilian effort from a multi-species fishery to one specifically targeting swordfish has almost certainly increased effort on the species in Brazilian waters and other areas along the Brazilian coast.

B. Catch

The Brazilian swordfish catch has fluctuated widely from year to year. Swordfish catches are in large part a function of the larger multi-species longline fishery which incidentally takes swordfish as only one of several target species. Foreign fishermen have played a key role in the development of the longline fishery. Swordfish has generally been a relatively small part of the foreign landings, but a more important part of the domestic fishery. The Brazilian swordfish catch reached record levels in the 1990s, reflecting the expansion of the fleet and changing fishing strategies. The bulk of the catch is usually landed by domestic fishermen, but vessels leased from foreign companies continue to land substantial quantities.

Available data on Brazilian catches varies substantially. The authors have compiled data from various sources, including FAO, ICCAT, IBAMA, and IP. Theoretically these data sets should have the same source, IBAMA/SUDEPE official national catch data. Unfortunately Brazil has a weak national statistical system.[335] As a result, a variety of often conflicting data sets exist. This is further complicated by the fact that Brazilian companies lease foreign longliners which gives them the right to fly the Brazilian flag. FAO thus counts their catch as part of the Brazilian catch even though it was taken by foreign vessels with only a partial Brazilian crew. Another complication is the propensity to update existing data sometimes several years after release and publication. In general, the authors have primarily relied upon the ICCAT statistics as the organization focuses on tunas and other large pelagics like swordfish and is able to give more attention to assessing the available statistics for these species than can FAO.

The major catch trends in the Brazilian longline fishery are as follows:

1950s: The Japanese first deployed exploratory longliners off Brazil in 1955.[336] FAO sponsored an assessment of the tuna fishery for the Brazilian Government in 1956. A U.S. master fisherman assessed the situation along the northeastern coast.[337] A Brazilian company initiated a longline fishery for tuna and tuna-like species in 1956 out of Recife in Pernambuco State by leasing a Japanese longliner.[338] The fishery by 1959 had expanded to 13 vessels.[339]

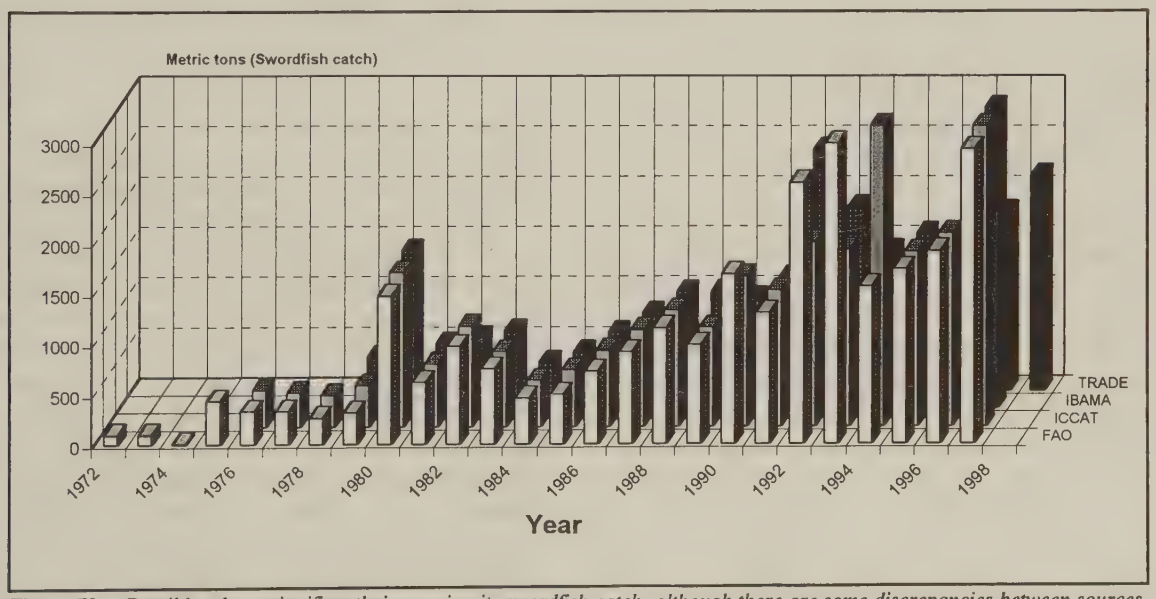


Figure 72.-- Brazil has been significantly increasing its swordfish catch, although there are some discrepancies between sources, especially data derived from export shipments.

The fishermen focused primarily on tunas. The authors have no actual data on swordfish catches during these early years, but it is known that there were swordfish bycatches.[340] The first Brazilian longliners were deployed out of Santos in 1958.[341]

1960s: The Japanese effort off Brazil expanded into a significant fishery. One report in 1961 suggests about 60 Japanese vessels were deployed off the northeastern coast.[342] This seems like a large number and the authors have no information collaborating this press report.[343] The leasing of the foreign longliners was discontinued in 1962. One author indicates that the Japanese operations out of Recife continued until 1965.[344] The authors have no catch data on their operations. The Brazilian Government reports that commercial longlining ended in Brazil, as there were no domestic commercial longliners.[345] Various Brazilian companies deployed longliners during the late 1950s and 1960s, but results appear mixed. The local fishermen reported excellent catch rates, but did not develop a commercial fishery in the early 1960s. They reportedly discontinued operations for tunas and other oceanic pelagics because, relying primarily on the domestic Brazilian market, they found that the low prices paid for the catch did not cover operating costs.[346] Some artisanal operations continued. One author explains that after the Japanese withdrew, a handful of self-employed fishermen occasionally targeted tuna.[347] Another author describes artisanal operations in Rio Grande do Norte (Formosa Bay).[348] Another observer reports that Brazilian fishermen began to deploy small longliners during the late 1960s. Various reports indicate that fishermen deployed a few small longliners out of Santos during the 1960s, but these accounts vary somewhat as to the number of vessels and years.[349]

Early 1970s: A Brazilian Government report indicated that domestic companies conducted no commercial longlining operations with domestic longliners during the early 1970s.[350] Another observer, however, reports that domestic fishermen deployed 3-9 longliners during the 1970s.[351] FAO reports swordfish catches of about 100 t in the early 1970s, although for unknown reasons very little was caught in 1974 (appendix E3b1b).

1975: Brazilian companies resumed commercial longline fishing in 1975 when they leased 6 Korean longliners.[352] Other observers report that both Japanese and Korean longliners were leased beginning in 1976 for operations out of Rio Grande.[353] FAO, which counts the catches of the foreign leased longliners as part of the Brazilian catch, reported a substantially increased 1975 catch of 435 t (appendix E3b1b).

1976: Commercial longliners caught about 1,420 t of tuna and swordfish in 1976. ICCAT reports that approximately 370 t or over 25 percent was swordfish (appendix E3b1a). Domestic fishermen deployed 1.1 million hooks, more or less the same effort they continued to deploy through 1980--about 1.0-1.4 million hooks (appendix D1a). Swordfish yields exceeded 34 kg per 100 hooks (appendix D2b). FAO reported a smaller catch of only 330 t (appendix E3b1a). The Brazilian Government approved new regulations authorizing Brazilian companies to lease foreign longliners. The 6 leased Korean longliners reportedly continued to operate, but no catch data is available.

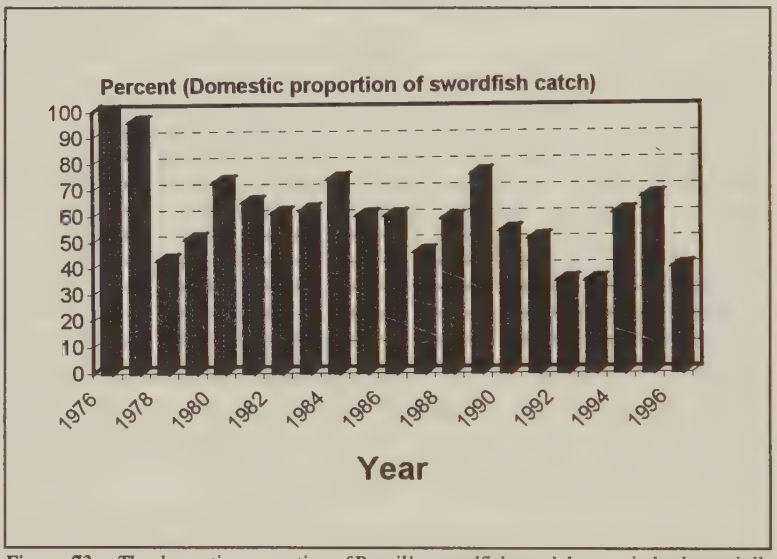


Figure 73.-- The domestic proportion of Brazil's swordfish catch has varied substantially from year to year, but is often about 60 percent.

1977: The domestic commercial longline swordfish catch fell to 330 t in 1977. The contracts with the leased Korean longliners expired. Brazilian companies in Rio Grande for the first time leased Japanese longliners, contracting 3 vessels (appendix A2c2a).[354] The leased Japanese vessels operated for just a few months in the south targeting tuna and swordfish. They caught 13-34 t of swordfish. They moved north to target tuna along the central coast (about 20°S) during November, but reported large catches of lower priced white marlin and sailfish.[355] Available data shows very large white marlin catches (appendix D1c).

1978: ICCAT reported that the domestic longline fleet caught less than 140 t of swordfish. The leased Japanese vessels, however, caught 180 t, the only year they landed more swordfish than the domestic fleet

(appendix E3b1a). The higher catch was due to the substantial increase in effort to 1.7 million hooks, a level they would subsequently reduce (appendix D2c). FAO reports lower catch levels of only 265 t for the combined foreign and domestic fleet (appendix E3b1a). The leased fleet expanded operations off southern Brazil. They returned to the central coast in December, but again encountered large white marlin and sailfish catches instead of the desired tuna and swordfish and thus decided to target other grounds in the future.[356]

Photo 81.--Japanese longline fishermen off Brazil laying their longline. Covered working areas and larger vessel size allow many of the foreign vessels off Brazil to operate in rough conditions.

1979: The domestic longline fleet reported a substantially increased swordfish catch. The domestic fishermen caught over 210 t of swordfish. The leased Japanese vessels caught about 200 t, one of the few years when their longline catches were comparable (appendix E3b1a). FAO also reported increased catches of over 320 tons.

1980: Although overall longline effort was only slightly changed, both the domestic and Japanese fishermen increased effort directed at swordfish (appendices D2b-c). Brazilian fishermen conducted their first directed swordfish operations.[357] The resulting record catch according to ICCAT was of more than 1,100 t for domestic fishermen. This was Brazil's record domestic swordfish catch until 1996 (appendix E3b1a). FAO reported slightly lower results. Most of this substantial catch was taken by the domestic fishermen and not the foreign fishermen. The domestic longline fishermen reported a record swordfish catch of 1,125 t, more than five times the 1979 catch. The domestic fishermen reported extraordinarily high catch rates of nearly 95 kg per 100 hooks (appendix D2b). Swordfish made up more than half the catch of the domestic longline fleet (appendix D2b). The leased Japanese fishermen also reported a record swordfish catch of nearly 410 t (appendix E3b1a). Swordfish made up over 50 percent of the domestic catch and 25 percent of the overall leased longline catch (appendix E3b1b). Although less than half of the proportion of the domestic fleet, this was a much higher proportion of swordfish than the 9-14 percent the Japanese usually reported.

1981: After the spectacular 1980 results, both domestic and leased vessels reported sharply lower swordfish catches in 1981. The fishermen appear to have shifted strategy and more heavily target tuna, as tuna catches increased. The swordfish catches declined by more than a half to 630 t, but was still well above historical results reported during the 1970s (appendix E3b1a).[358] The swordfish catch of both the domestic and leased vessels declined. The foreign fishermen, however, reported record overall catches (including tunas and other species). They noted record CPUE levels, in part due to a heavy concentration of effort during the winter months and operations exclusively off the southern coast where yields were the highest.[359]

1982: Both domestic and Japanese fishermen operating leased vessels substantially increased effort and achieved increased swordfish catches which combined exceeded 1,000 t (appendix E3b1a). Both domestic and foreign fishermen reported improved results.

1983: Domestic and leased vessels both reported declining swordfish catches in 1983-94. Domestic fishermen caught only 470 t of swordfish. While fishermen increased effort substantially, deploying four additional longliners and exceeding 2 million hooks for

the first time, catch rates declined by nearly 50 percent to 20 kg per 100 hooks (appendix D2b). The Japanese fishermen operating leased vessels reported a swordfish catch of only 280 t (appendix E3b1a). The decline resulted from a reduction in the fleet and the fact that the remaining vessels only fished through the middle of the year.[360] The foreign leased effort declined to 1.8 million hooks, still a relatively high level (appendix D2c)

1984: The total swordfish catch declined further to only 460 t in 1984, the lowest catch since 1979 (appendix E3b1a). Both domestic and foreign fishermen reported lower catches. The catch of the foreign leased vessels fell to the lowest level after the leasing program was initiated in 1977--landing only 120 tons of swordfish. FAO, ICCAT, and SUDEPE (the former fisheries agency) reported virtually identical data. Domestic fishermen continued to operate 12 longliners and expanded effort to 2.6 million hooks, but the catch declined to only 340 t and yields to only 13 kg per 100 hooks, the lowest level since 1978 (appendix D2b). Swordfish made up 25 percent of the overall domestic longline catch (appendix E3b1b). Although substantial and above the levels reported during the later 1970s, the proportion of swordfish by 1984 had declined 50 percent from the record high levels reported in 1980. The Japanese fishermen operating longliners withdrew one longliner and effort fell to 1 million hooks, the lowest level since the Japanese vessels were first leased in 1977. The leased vessel swordfish catch fell to only 120 t and yields were only 11 kg per 100 hooks (appendix E3b1a and D2c). The Japanese reported that swordfish was only 10 percent of their overall longline catch (appendix E3b3b).

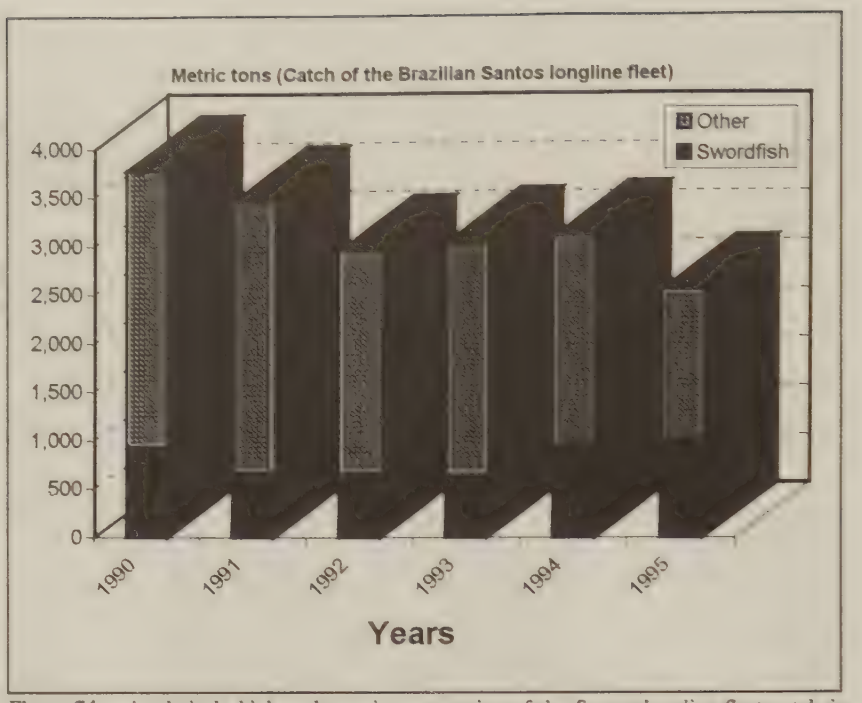


Figure 74.-- A relatively high and growing proportion of the Santos longline fleet catch is swordfish.

1985: The longline fleet fell to only 13 vessels (appendix A2a1). The domestic swordfish catch, however, changed little, remaining at about 340 t (appendix E3b1a). Brazilian longline fishermen reported increasing catches of sharks.[361] One longliner was refitted to surface gillnet operations.[362] The foreign leased vessels reported improved results with catches of nearly 230 tons.

Photo 82.--The catch of this longliner can be seen in the hold with the ice slury to maintain freshness. Dennis Weidner

Photo 83.--Swordfish and other species being hauled out of the hold. Note use of plastic protective bags. Dennis Weidner

1986-89: Catches reached 1,160 t in 1988, but declined slightly to 990 t in 1989 (appendix E3b1a). Most of the catch was taken by domestic fishermen, an unusually high 76 percent (appendix E3b1c). The Japanese fishermen increased effort to a record 2.2 million hooks in 1986 and maintained effort at about that level through 1990 (appendix D1d). The greatest fishing effort by the Japanese leased fleet was reported from 1986-90, with an average of 2.2 million hooks deployed annually. The peak deployment was 2.4 million hooks in 1988 (appendix D1d). The overall longline catch did not increase proportionally.[363] The swordfish catch pattern is less clear and shows sharp, unexplained annual fluctuations.[364] The swordfish catches of the leased Japanese vessels increased to a record 511 t in 1987, but declined to nearly 240 t in 1989 (appendix E3b1a). The swordfish CPUE for 1987 was well above average, but in 1989 fell sharply (appendix D2f).

1990-91: Catches according to FAO reached a record of nearly 1,700 t in 1990, but declined in 1991 to only 1,300 t (appendix E3b1a). The decline was primarily due to the lower catches of the domestic fleet (appendix E3b1a). Many Japanese vessels withdrew from the fishery in 1991, but were replaced by Taiwan longliners. The Japanese leased fleet reported an all-time record catch of nearly 680 t in 1990 as the Japanese/Taiwan leased fleet reported similar results in 1991. The Japanese leased vessels reported sharply higher CPUE levels in 1990, but the CPUE fell in 1991 below average (appendix D2f). It is unclear why the Japanese reduced operations, but Leal Santos signed a new contract in 1991 to lease 11 Taiwan longliners.[365]

1992: The expanded fleet of longliners from Taiwan enabled Brazil to report a record catch of 2,600 t of swordfish in 1992 (appendix E3b1a). The domestic fleet caught a little over 600 t in 1992. The Taiwan leased fleet, however, caught nearly 1,900 t of swordfish, bringing the total to about 2,600 t (appendices E3b1a and E3b3a). Substantial albacore and yellowfin catches were also reported (appendix E4a).

1993: The reported swordfish catch declined slightly to only 2,000 t in 1993 (appendix E3b1a), but was still well above historical levels. The domestic catch increased slightly to 670 t, but Taiwan leased operations fell to only 1,200 t--reducing the overall catch. Some observers are concerned about the accuracy of available statistics. Some observers believe that catches were increasing, perhaps significantly.[366] Available data

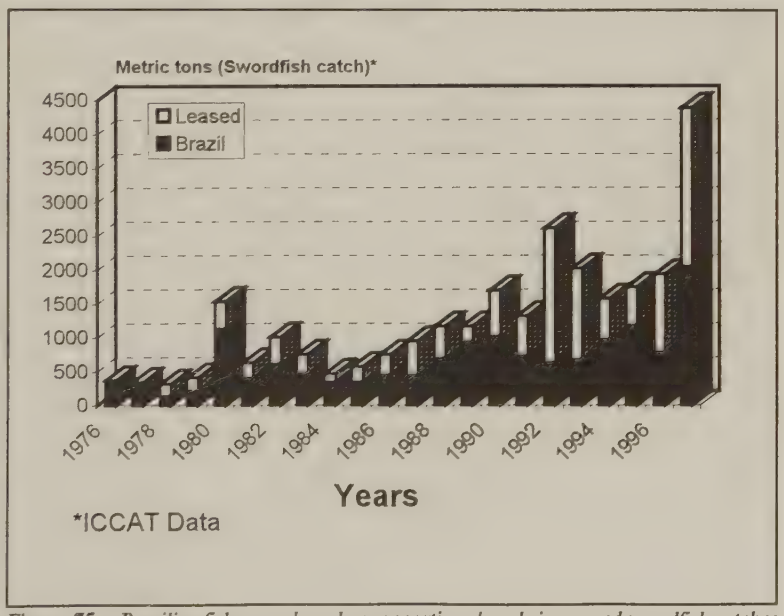


Figure 75.-- Brazilian fishermen have been reporting sharply increased swordfish catches since 1993. Foreign catches were particularly big in 1992 and 1993.

Photo 84.--Cabedelo is primarily an artisanal fishing port, but several foreign longliners operate out of the commercial cargo port. Dennis Weidner

on trade flows show increased shipments in 1993 (appendices E3b1a and G1a).

1994: American swordfish fishermen in 1994 began working with Brazilian fishermen. The results they achieved using monofilament to target swordfish, rather than conducting more traditional Japanese-style multi-species operations, caused several fishermen to shift operations.[367] (See "Fleet Operations and Gear".) As a result, the species composition of the Brazilian longline catch began to shift. The proportion of swordfish increased to over 50 percent while the proportion of sharks fell to less than 40 percent of the catch (appendix E3b1b and E4c1).[368] Brazil's overall swordfish catch declined to only 1,600 t (appendix E3b1a). This was primarily because of a major reduction in Taiwan operations, only partially offset by strong Honduran landings. The Taiwan leased catch fell to only 200 t (appendix E3b3a). The Brazilian domestic catch, however, increased substantially and approached 1,000 t (appendix E2b1a). This meant that the domestic fishermen took over 60 percent of the swordfish catch, the highest proportion since 1989 (appendix E3b1c).

1995: One observer notes that seven Santos-based longliners had shifted from the multi-species Japanese style operations to directed swordfish fisheries using monofilament line by October 1995.[369] FAO, ICCAT, and Brazilian sources report that the overall swordfish catch increased slightly to 1,700 t (appendix E3b1a). The domestic catch increased to nearly 1,200 t, but the leased catch declined slightly. The principal country continuing to lease vessels was Taiwan, but the swordfish catches were only a fraction of those reported in 1992-93 (appendix E3b3a). Trade flows suggest only modest exports, but industry sources contend that most of the domestic catch was exported.

1996: After strong catch increases in 1994 and 1995, the Brazilian domestic feet reported catches of less than 800 t in 1996. The overall Brazilian swordfish catch, however, increased to more than 1,900 t (appendix E3b1a). The reason for the increase was expanded leased catches. The foreign fishermen landed over 1,000 t of swordfish--double 1995 catches. The increase was mostly due to the entry of Spanish vessels into the leasing program. The Spanish had conducted a massive south Atlantic fishery since 1988, but operated on the highseas and did not previously participate in the leasing program. U.S. fishermen for the first time participated in the leasing program, but catches were only a little over 100 tons. Available import data shows substantial increases in swordfish shipments from Brazil--more than doubling (appendices E3b1a and G1a). This would suggest that Brazilian fishermen increased catches in 1996, but actual domestic catch shows a decline (appendix E3b1a). The authors cannot explain this discrepancy. One

possibility is that some of the Spanish catch is being landed fresh and exported to the United States, but the authors have no information to substantiate this.[370]

1997: Preliminary data suggests that both Brazilian and foreign fishermen operating under lease arrangements achieved a very substantial catch increase in 1997. Data was only preliminary at the time this report was finalized, but the Instituto de Pesca (IP) reports that Brazilian domestic catches in 1997 exceeded 2,000 t for the first time. The actual catch was 2,040 tons.[371] The authors do not have fleet trend data for 1997 so are unsure how much of this increase was due to possible fleet expansion. ICCAT sources indicate that the number of vessels did increase in 1997.[372] Expanding operations further offshore appears to have been another factor. One key reason was certainly the increasing use of U.S. methods which focus more on swordfish as a target species. Most of the fleet has switched over to monofilament. One ICCAT report, for example, suggests that 9 of 13 vessels operating off the northeast coast had switched to monofilament line.[373] UFRPe researchers confirm that the increasing use of monofilament gear and U.S.-style fishing methods is the principal reason for the increase.[374] The catch of the leased foreign vessels also increased to a record 2,200-2,300 tons.[375] This increased leased catch was primarily because of expanding Spanish fishing. The Spanish leased vessels caught over 1,100 t of swordfish, more than double 1996 levels (appendix E3b3a). U.S. leased catches increased, but were still under 300 tons. U.S. distant-water catches totaled nearly 400 t (appendix E3a1). The substantial Brazilian catch increase is roughly confirmed by available U.S. trade data. U.S. import data suggests significant catch increases. The live weight equivalent of imports from Brazil doubled in 1996 to over 800 t (appendix E3b1a). This slightly exceeded the total Brazilian catch. Some of the increase can be explained by the entry of U.S. vessels into the fishery in 1996. Virtually all of their 266 t swordfish catch would have been exported to the United States. The disparity between the domestic catch and exports in some years is difficult to explain (appendix G1b1). The most likely possibility is that some of the other leased vessels are shipping their catch to the United States. Another possibility is faulty statistics. The year 1997 appears in many ways to have marked a major shift in the Brazilian fishery. One of the important companies operated by Japanese-Brazilians collapsed in 1997 and its vessels (Tooshin Maru series) were withdrawn from the fishery. Even so the reported domestic catch increased sharply, for several reasons. First, several new Brazilian groups entered the fishery, some of which are investing in new vessels. Second, Brazilian captains open to new gear and methods replaced retiring elderly Japanese

Photo 85.--The leased Portuguese longliner "Rio Pravia" operated along the northeastern coast in 1998, primarily from Cabedelo. Dennis Weidner

Photo 86.--Brazilian fishermen reported major catches increases in 1997, in part due to the expanding use of monofilament gear. Preliminary indicators suggest comparable 1998 catches. D. Weidner

captains. Third, a continued shift to U.S.-style fishing methods (monofilament, light sticks, shorter lines, and squid baits) and directed swordfish sets. Fourth, the deployment of several small boats, some as small as 12 m in length, equipped with monofilament. These vessels are much smaller than the Japanese style longliners that have been used in the past. They reportedly, however, have achieved considerable success. They could make a substantial contribution to the fishery in future years.[376]

1998: The authors have no Brazilian catch data for 1998. Anecdotal accounts from the fishermen suggest good 1998 catches, but that some fishermen are reportedly redirecting effort to other species because of low prices. Other fishermen are reportedly continuing to fish, but expanding domestic marketing. At the prices prevalent in mid-1998, the domestic market represented an attractive alternative, although the domestic consumer is not generally familiar with the species. U.S. import data is a good indicator of catch trends in many Latin American fisheries oriented toward export markets. It can generally be used in fisheries like those for shrimp and lobster to estimate catch trends when domestic catch data is not readily available. The same is true of the swordfish fishery in other Latin American countries (Chile, Costa Rica, Ecuador, Mexico, Uruguay, Venezuela). The U.S. import trends do not, however, always appear to track either the domestic or leased catch trends (appendix E3b1a). It is probably because some, but not all, of the leased vessels land fresh product and export it to the United States. Available evidence suggests that several countries operating leased vessels are exporting to the United States (Barbados, Honduras, Portugal, and the United States). The fishermen from several other countries (Japan, Korea, Spain, and Taiwan) do not appear to be targeting the U.S. market, in part because they mostly produce frozen product. While the U.S. import data does not appear to have been a good indicator of published catch trends, it is hard data which must be taken into account when evaluating available Brazilian catch data. The U.S. data available for 1998 (through September) show a record level of imports. Shipments from February through July exceeded 100 t and in 3 months were near or over 150 tons. Shipments during the first half of 1998 were at record levels, each month in 1998 exceeding the comparable 1997 month. This continued until August when imports fell below 100 t and were only half of the 180 t reported in August 1997 (appendix G2g). September and October 1998 shipments exceeded 100 t, but were far below 1997 levels. It is to early too tell if this constitutes a major shift in the import trend or was an anomalous month. Reports from Brazil do not reflect any major shift in Brazilian fishing during August 1998. Rather than reflecting catch trends, the August shift in U.S. imports may well reflect market trends with fishing companies reacting to the falling price trends on the U.S. market by expanding domestic sales Even so, shipments to the United States in 1998 will set an all-time record and total about 1,400 tons.

VIII. Ports

Brazilian and foreign fishermen deploy longliners from several different ports. The ports utilized have varied over time depending on the species targeted, grounds, and nationality of the fishermen.

Cabedelo (Paraiba): Longliners sometimes call at the northern port of Cabedelo, near João Pessoa in Paraiba State. The cold storage capacity at the port is very limited.[377] The commercial longline operates from the commercial cargo port which can handle large vessels. Leased Taiwan longliners in 1995 primarily operated out of Cabedelo.[378] Much of the expanding effort off northeastern Brazil of the leased fleet is conducted from Cabedelo. The foreign activity in 1998 included Portuguese, Spanish, and Taiwan longlines. The Spanish in particular target swordfish and have been especially active in Cabedelo during 1997 and 1998. Some artisanal longlining has also been reported, but with little success.[379]

Itajaí (Santa Catarina): Longliners have not normally operated out of Itajaí in Santa Catarina state (appendix A1c). Only small numbers of longliners were reported in the early 1990s. Some coastal boats, however, using driftnets and gillnets targeting hammerheads and other species operate from Itajaí.[380] Increasing numbers of longliners have been reported since 1996. Apparently, rising port changes at Santos have caused several companies to shift vessel operations to Itajaí. In addition, some Itajaí companies have initiated longline operations.[381] The major companies are Amaral, Kowalsky, and Estaleiro Naval São Pedro. Itajaí has become the most important fishing port in southern Brazil.[382] The swordfish landed at Itajaí are trucked to São Paulo for air shipment from the Guarulhos International Airport to the United States. Important shipyards are located at the port. Some companies have reportedly began to use these yards as prices in Santos yards have increased. (See: "Shipyards.")

Natal (Rio Grande do Norte): Natal has become one of the most important ports for the longliners operating along the northern coast. It was the site of an important World War II air base for the Allies and is now the principal cargo port in Rio Grande do Norte (RGN). A Brazilian company deployed a small longliner out of Natal in 1983.[383] Only one to three Brazilian longliners were active until 1989 when the number was increased. The longliners operated off the northeast coast. The peak activity was reported in 1990 when 10 longliners were active, but in 1994 only three longliners were reported (appendix A1c). The

Photo 87.--Cargo port of Cabedelo, north of João Pessoa where leased foreign longliners have been landing their catch in the late 1990s. Dennis Weidner

Photo 88.--Natal has become a key port for Brazil's northeastern longline fishery. Dennis Weidner

Photo 89.--Natal is one of the busiest fishing ports in the northeast. Mostly artisanal vessels use the port, but several commercial longliners are also active. Dennis Weidner

Photo 90.--The foreign-leased longliner "Cape Horn" in 1998 worked with Norte Pesca out of Natal. Dennis Weidner

Photo 91.-- The Brazilian longline fishery was initiated out of Recife in the 1950s, but in the late 1990s, there was very little longline activity there. Dennis Weidner

reason for the peak of activity in 1989-90 is unknown. Four major fishing companies are active at the port with cold stores totaling 2,000 tons. The most active company in the longline fishery is Norte Pesca, but a new company (Enpesca) entered the fishery in 1998. Activity increased again in 1997 and 1998. Larger vessels at first had to use the commercial port, but this proved expensive and inefficient. The fishing boats received low priority and would have to move whenever a cargo vessel arrived. Norte Pesca has since enlarged its pier and most vessels using Natal now dock there. IMPESCA in 1998 was handling its own vessel at its pier. Some companies have reported problems with port services such as unloading times as well as poor quality fish taken off the northeast.[384]

Photo 92.--Only one longliner, the "Otero," was active out of Recife in 1998. Most of the domestic longline fleet along the northeastern coast worked out of Natal. Dennis Weidner

Recife (Pernambuco): Recife has played an important role in the development of the longline fishery. The first commercial longliners deployed off Brazil were Japanese boats based in Recife, the principal port in the state of Pernambuco. Operations were initiated in 1956 and continued until 1971.[385] The Japanese longliners targeted tropical tunas off the northern coast.[386] Several processing companies are active in Recife and the cold storage capacity is well over 10,000 tons.[387] Some limited activity was reported in 1998. The longliner *Otero* is the only longline known to have operated from Recife during 1998. Most of the fishing from the northeast in 1998, however, is conducted from either Natal or Cabedelo.[388]

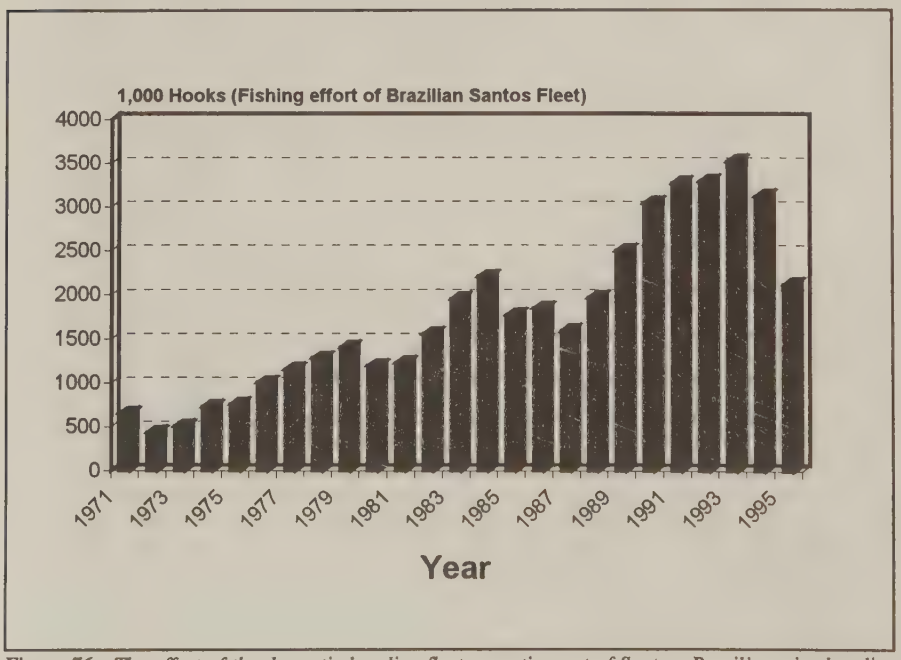


Figure 76.--The effort of the domestic longline fleet operating out of Santos, Brazil's major longline port, steadily increased in the 1970s and 80s, but declined in 1994 and 1995.

Rio Grande (Rio Grande do Sul): Rio Grande is a major port complex in the southernmost Brazilian state of Rio Grande do Sul, serving one of the most productive agricultural areas in Brazil. Most of the fishing fleet is based at the Old Port adjacent to the city of Rio Grande itself. The Old Port can handle vessels with drafts up to 5 meters. Quite a large variety of vessels use the Old Port. There are facilities for artisanal fishermen landing fish daily in open boats as well as extensive piers for small commercial vessels. Quite a number of Rio Grande

Photo 93.--Small boats docked at the main Rio Grande do Sul fishing port. Dennis Weidner

fisheries are conducted from other Brazilian ports and a number of Rio Grande fishermen have gained experience by working on foreign vessels. In addition, Rio Grande is located close to some of the best fishing grounds located off southern Brazil. Local observers provide various explanations concerning the failure of local companies to develop a successful longline fishery out of Rio Grande. One local official believes the primary reason is the lack of education and training received by Brazilian fishermen many of whom engage in subsistence fishing without any formal training. He points out that even the Brazilian crew members on the leased Japanese vessels do not receive training in the more sophisticated

fishermen operate small commercial vessels ranging in size from 10-20 m, which deploy trawls, gillnets, and seines. Several vessels also deploy gillnets for coastal sharks. In the channel leading to Rio Grande from the sea are two larger ports capable of handling large ocean-going cargo vessels. The regular old cargo port can handle vessels with drafts up to 9 meters. The Super Port can handle vessels with drafts of 10-30 meters.[389] Only a few domestic longliners have operated from Rio Grande. The authors know of only two domestic longliners which were deployed during the mid-1980s.[390] It is unclear why Rio Grande companies have not been able to successfully conduct a tuna/swordfish longline fishery. Such

Photo 94.--Large numbers of foreign longliners operated from Rio Grande do Sul in the mid-1990s, but currently only the live-bait tuna fishery is active. Dennis Weidner

Photo 95.--Brazilian fishermen working on their gillnet at Rio Grande do Sul. Expanding gillnet fisheries are taking large numbers of sharks and billfish in Brazilian coastal waters. D. Weidner

operations.[391] Another observer indicated that some of the most experienced Brazilian longliner fishermen are from the tropical northeastern states and find the climate in more temperate Rio Grande too cold.[392] Another key factor is probably the limited Japanese-Brazilian population in Rio Grande; one reason that the domestic longline fishery has developed in Santos is that there is a large Japanese-Brazilian community in the São Paulo area. Many of the individuals with technical knowledge and experience who operated Brazilian longliners were Japanese who emigrated to Brazil. These individuals found it easy to work and live in Santos because of the large Japanese-Brazilian population in nearby São Paulo. In addition, the limited Japanese population in Rio Grande meant that there was not a receptive local market for the longline catch. (See: "Santos".) While Brazilian companies have not developed a local longline fishery, Rio Grande has since 1976 been the principal port used by the successful effort where local companies leased longline vessels from foreign countries (appendices A1c and A2c2a).[393] The first leased vessels were reported in 1976 and during the 1970s and 1980s, almost all of the leased vessels were Japanese, most of which were leased by Leal Santos. (See: "Companies.") About 2-6 foreign longline vessels were leased annually until 1990 (appendix A2a1).[394] Beginning in 1992 much larger numbers of foreign vessels (north Taiwan vessels) were leased

Photo 96.--Many Brazilian ports have active artisanal fleets similar to the vessels here in Natal. Dennis Weidner.

Photo 97.--These fishermen at Rio Grade do Sul set driftnets in coastal waters, taking sharks and billfish, but rarely swordfish. Dennis Weidner

by Rio Grande companies. The primary company contracting with the foreign companies has been Leal Santos (appendix A2c3). The company has its own port facilities at the Super Port and the foreign longliners land their catch there. Leal Santos also deploys baitboats to supply skipjack to its cannery. Another Rio Grande company, Pesca, also arranged for trials with Taiwan fishermen during 1994. For unknown reasons, the foreign companies decided not to seek leasing agreements with Rio Grande companies in 1996.

Santos (São Paulo): Santos is Brazil's principal port, serving the huge industrial urban complex of São Paulo in São Paulo state (SP). Santos is also one of Brazil's major fishing ports and the center of the domestic longline fleet (appendix A1c). The Terminal Pesqueiro de Santos has a 200-m pier and a building with an area of 1,000 square meters for processing and marketing fish.[395] Santos offers several advantages which explain why it is the center of the domestic longline fleet. The large Japanese-Brazilian population in neighboring São Paulo provides a comfortable community to attract Japanese fishing experts during the 1960-70s. In addition, the local Japanese population provides a receptive local market, willing to pay much higher prices than other Brazilians, for the longline catch. The first domestic longliners were acquired by a Brazilian company and operated from 1958 through 1961 with three longliners targeting tunas off the southern and southeastern coast.[396] Another company resumed longline operations in 1965 with two longliners and another company added more vessels in 1969, again targeting tunas and swordfish off the southeast and southern coast.[397] Other longliners were deployed out of Santos beginning in 1982, but the fishermen shifted operations during the 1980s depending on the target species and grounds.[398] Brazil's fleet of coastal longliners during recent years is primarily based in Santos, except during 1989-90 when an unusual number of vessels operated out of northeastern ports (appendix A1c). Sharks make up a substantial part of the catch of the Santos fleet.[399] The vessels have ice holds and land fresh product. The fish is landed at the docks by the Terminal de Pesqueiro which has extensive marketing facilities. The swordfish is mostly exported and the large Japanese-Brazilian community in nearby São Paulo which provides a ready market for high quality tunas. Only a few of the leased foreign vessels have been based in Santos (appendices A1c, A2a2 and A2c3). Longline activity in Santos has declined since 1996. Many fishermen report that costs of the port have become very expensive.[400]

Other: There are marinas located near major cities and resort areas offering services for recreational boating and sport fishing. One of the largest is the Marina Porto Real, located between Rio de Janeiro and Santos/São Paulo, 8 km from Ilha Grande. Several charter operations are available there. The marina is located in a resort area with many hotels and other facilities. There are berths for over 800 boats. Boats of up to about 35 m can be docked there. A variety of 24-hour services are available, as well as a heliport.[401]

Photo 98.--The Terminal Pesqueiro in Santos (TPS) located adjacent to the fishing pier. The longline catch is auctioned here. Dennis Weidner

Photo 99.--The Santos dock workers have a lot of experience landing the catch. Unloading at some other ports can take several days. Dennis Weidner

Photo 100.--Fishing Pier at Santos where both domestic and leased longliners land their catch. It is then immediately carted to the adjacent Terminal Pesqueiro for auction. D. Weidner

Photo 101.--The pier at the Santos Fishing Terminal can be quite crowded when several longliners are in port. Dennis Weidner

Photo 102.--Santos is Brazil's principal longline port, but in 1997 and 1998 many longliners shifted operations to other ports. Dennis Weidner

IX. Transshipments

The authors know of no transshipping of swordfish or other oceanic pelagics through Brazilian ports. There have been unconfirmed reports of such activity. One such report indicated, for example, that Spanish longliners operating out of Montevideo were landing swordfish in Brazil.[402] Brazilian sources deny these reports.[403] There have been reports, however, of substantial numbers of foreign vessels (especially Spanish vessels) claiming emergencies at sea and then coming into Brazilian ports. Unconfirmed reports suggest that, at this time, some of the boats off-load at least part of their catch. It is possible that some of this product could have been exported.[404]

Photo 103.--Two Taiwan longliners moored in Montevideo after transshipping their south Atlantic catch. Dennis Weidner

Brazilian companies during the 1990s have been leasing longliners from several different countries, rather than just the Japanese companies which provided vessels during the 1970s-80s. The vessels leased from flag-of-convenience countries (Honduras and Panama) are reportedly owned by fishermen from other countries. At least a few of these vessels reportedly have Spanish owners. (See: "International".) While the arrangements involved (appendix A2c1) are not precisely mere transshipping activities, the results are somewhat similar. They enable foreign-flag longliners to land and export swordfish and other oceanic pelagics. This activity might thus be classified as transshipping. If so, the level of transshipping through Brazil would be significant. The level can be calculated on the basis of the foreign-leased catch.

Photo 104.--Foreign vessels cannot transship through Brazilian ports. They can land fish in Brazilian waters if they have leasing contracts with domestic companies. D. Weidner

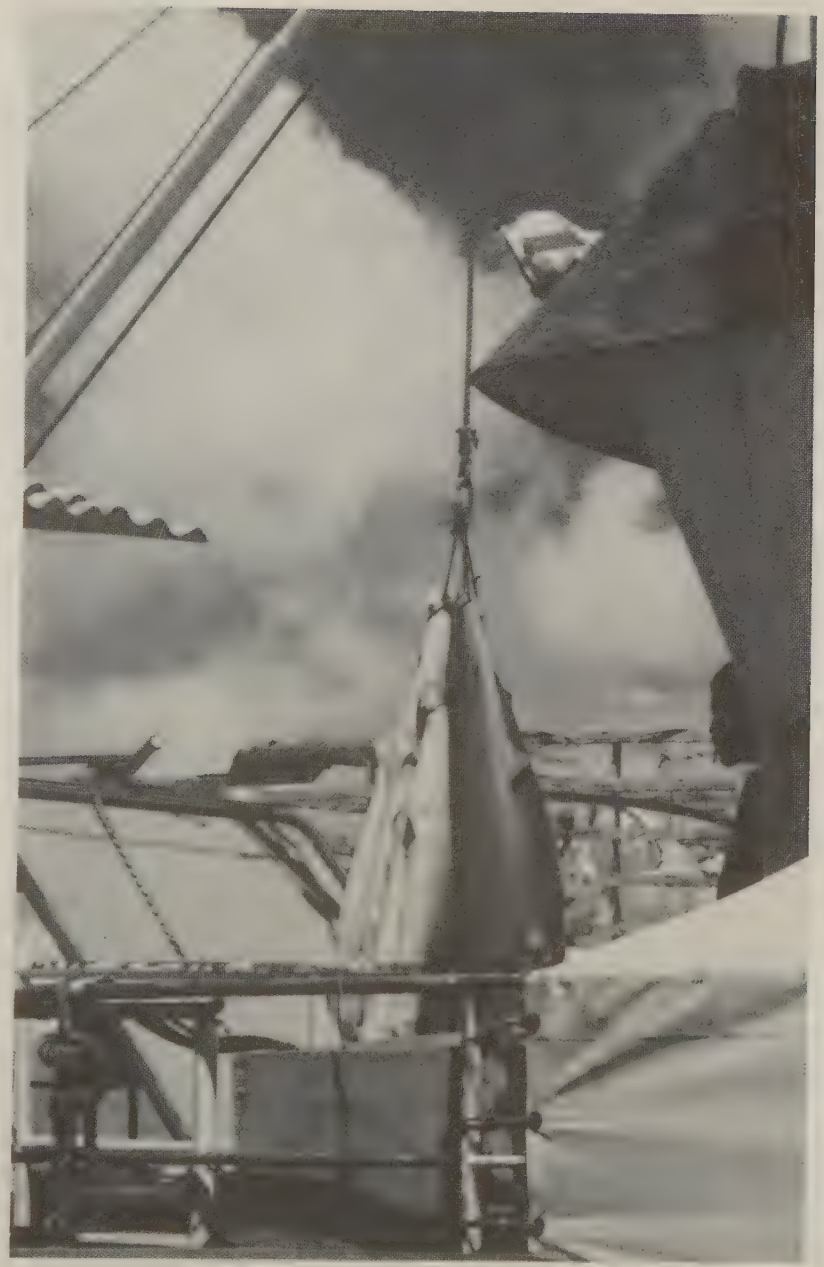


Photo 105.--Some Brazilian fisherman separate the catch in the hold and land the most valuable species like swordfish first. Dennis Weidner

Photo 106.--The sharks, which are of less value, are landed last. Dennis Weidner

X. Processing and Products

Most of the Brazilian swordfish catch is exported. No data exists on the quantities marketed domestically, but based on conversations with Brazilian companies, normally as much as 90 percent of the landings are exported as trunks without further processing. The trunks are landed and immediately packaged and trucked to the local airport. Shipping patterns vary somewhat by port. Only small quantities of swordfish are marketed domestically and only a part of that is processed into value-added products. Brazilian consumers are generally unfamiliar with swordfish. Low export prices in 1998 have caused companies to expand the local market, and domestic consumption in 1998 is increasing. Brazilian exporters have not yet seriously addressed the problem of product quality, which significantly affects the prices accorded to shipments from Brazil.

Photo 107.--Norte Pesca workers began washing and processing the longline catch as soon as it was off-loaded; the catch is not left sitting on the dock. Dennis Weidner

A. Port handling procedures

Handling procedures differ somewhat at the various Brazilian ports where swordfish is landed.

Natal: Almost all the swordfish caught at Natal in 1998 is landed at the Norte Pesca dock, including the catch of company vessels, fishermen working in association with Norte Pesca, and leased vessels. Norte Pesca provides a full range of services and packing, including trucks to deliver the export product to the Natal airport.[405] A new company, EMPESCA, initiated swordfish operations in 1998. While swordfish landings were limited in its first year of operations, the company hopes to

Photo 108.--The catch landed at the Norte Pesca plant in Natal is immediately cleaned and processed. Dennis Weidner

Photo 109.--The swordfish are washed at the Taiyo/Imaipesca plant in Santos and packed with gel packs in insulated cardboard containers. Dennis Weidner

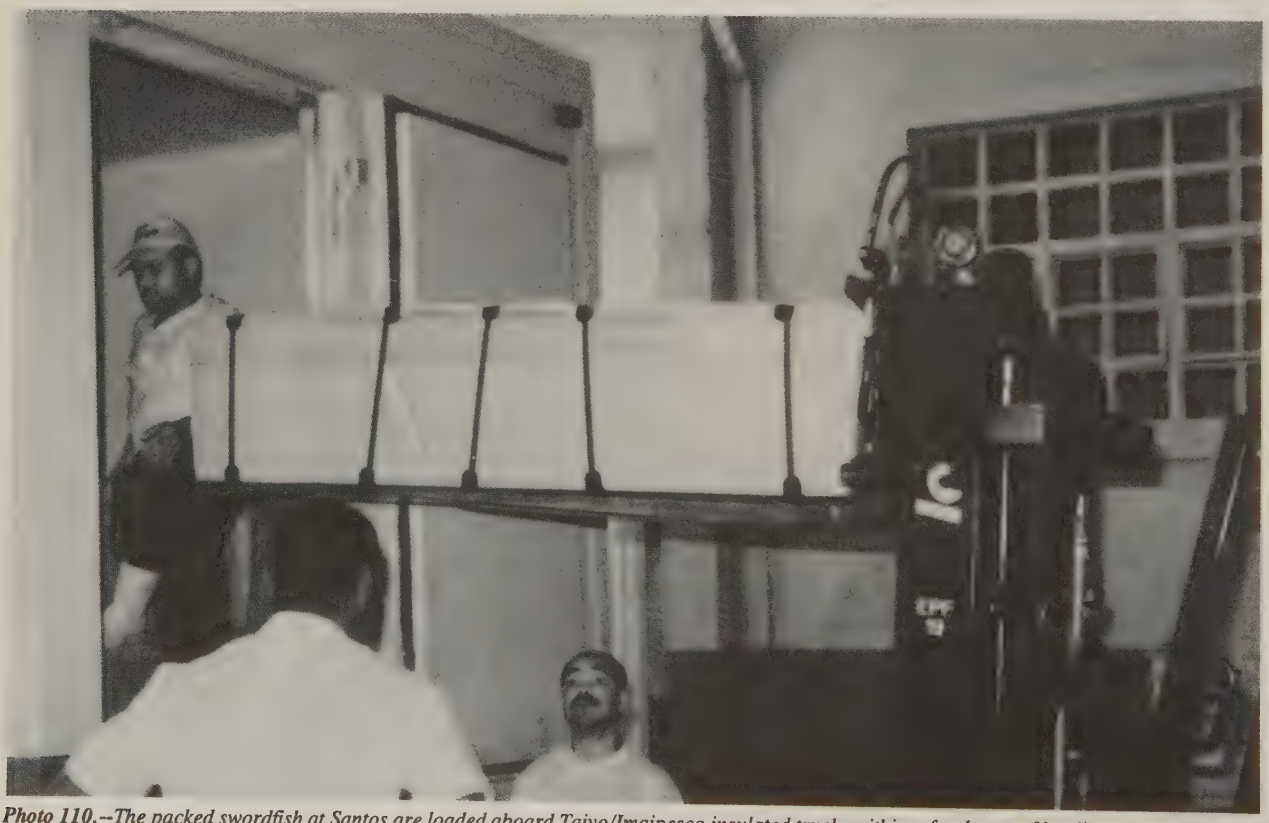


Photo 110.--The packed swordfish at Santos are loaded aboard Taiyo/Imaipesca insulated trucks within a few hours of landing. Dennis Weidner

Photo 111.--The loaded Taiyo trucks at Santos will deliver the swordfish to the Guarulhos (São Paulo) International Airport in about an hour. Dennis Weidner

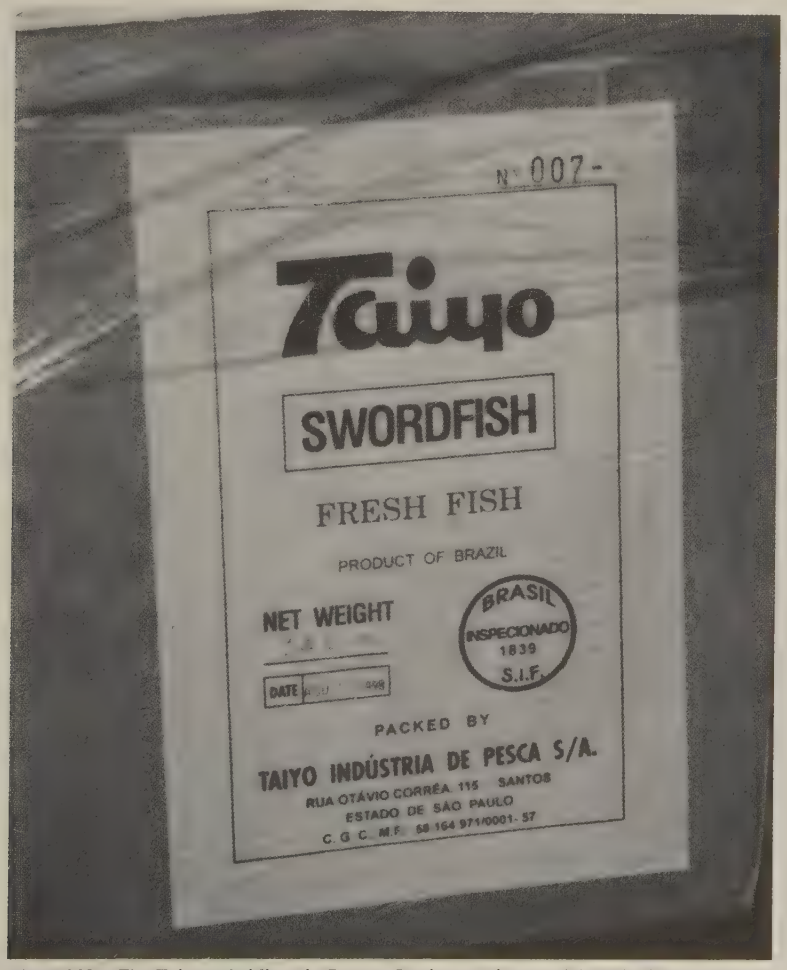


Photo 112.--The Taiyo subsidiary in Santos, Imaipesca, is one of the principal companies in the Brazilian swordfish fishery. Dennis Weidner

substantially increase their landings in 1999 with the delivery of two new purpose-built longliners.

Rio Grande: The swordfish landed by the foreign-leased vessels operating out of Rio Grande (RGS) landed their catch frozen at the port. Most of the catch was swordfish and tuna because the foreign vessels, mostly Taiwan vessels, discarded much of the shark catch. Leal Santos, the primary company which worked with the foreign longliners, then packed the trunks in cardboard boxes and trucked them to Porto Alegre where they were flown on to the big international São Paulo airport (Guarulhos) for export shipment--mostly to the United States.[406]

Santos: Much of the swordfish landed in Santos during 1996 was handled by Comércio de Pescados Caiçara. The company handles the fish for the fishermen, picking up the fresh trunks at the Santos Terminal de Pesca, packaging them in cardboard boxes with dry ice or gel packs at the company's processing plant, and trucking them to the São Paulo international airport (Guarulhos) for export shipment.[407] Imaipesca handles its own fish and assists many smaller operations with export shipment.[408] Several other companies handle export shipments.

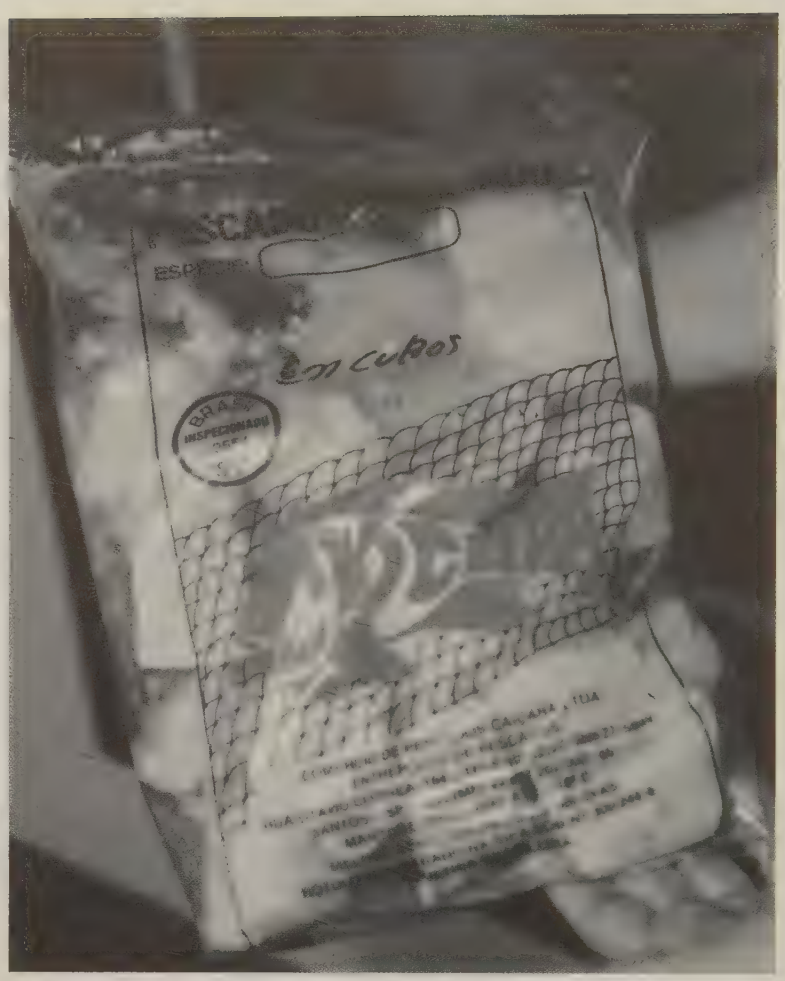


Photo 114.--The CPC company produces and markets frozen swordfish cubes for barbecuing. Dennis Weidner

Photo 113.--A modern fleet of insulated and refrigerated trucks move the commercial longline and artisanal catch from the port to inland markets. Dennis Weidner

Photo 115.--Sharks are a major part of the Brazilian longline catch. The carcasses, once discarded, now sell well in the domestic market. Dennis Weidner

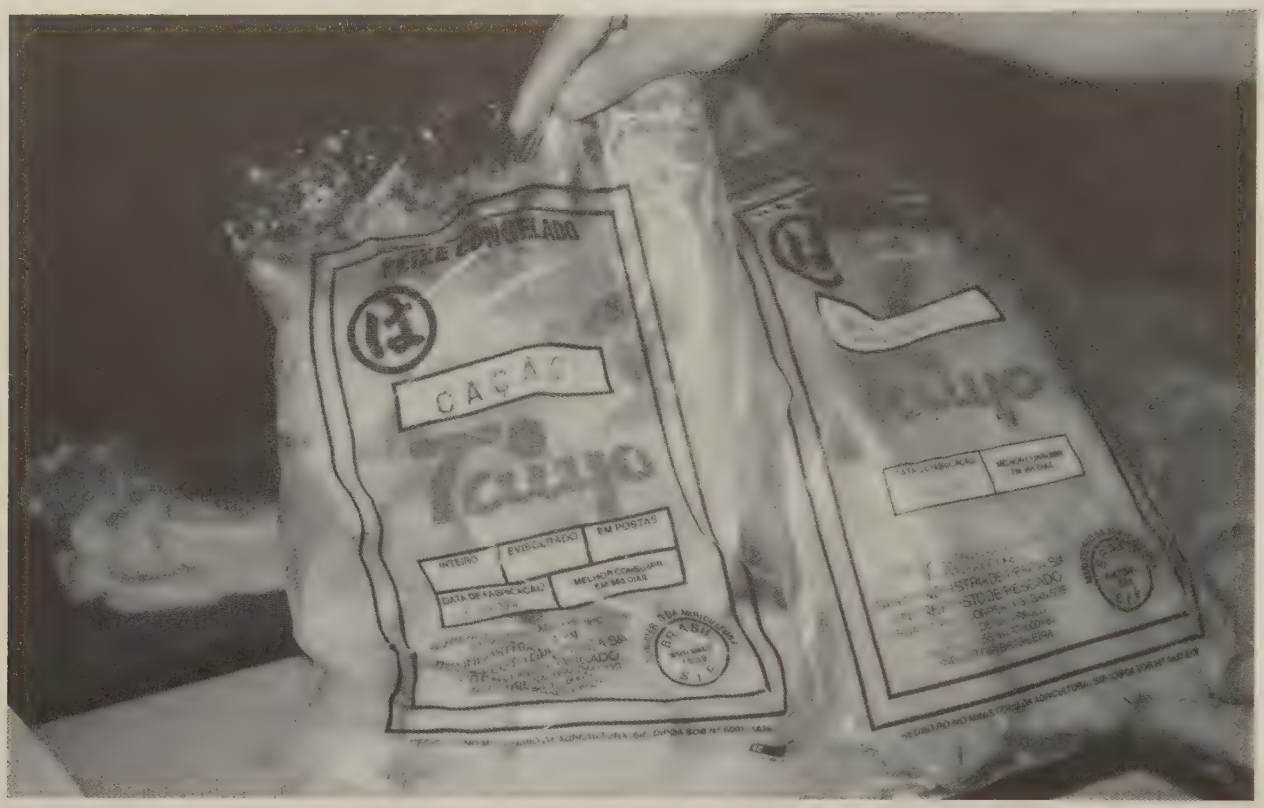


Photo 116.--Imaipesca (a Taiyo joint venture) produces frozen packs of shark and other species for the domestic market. Dennis Weidner

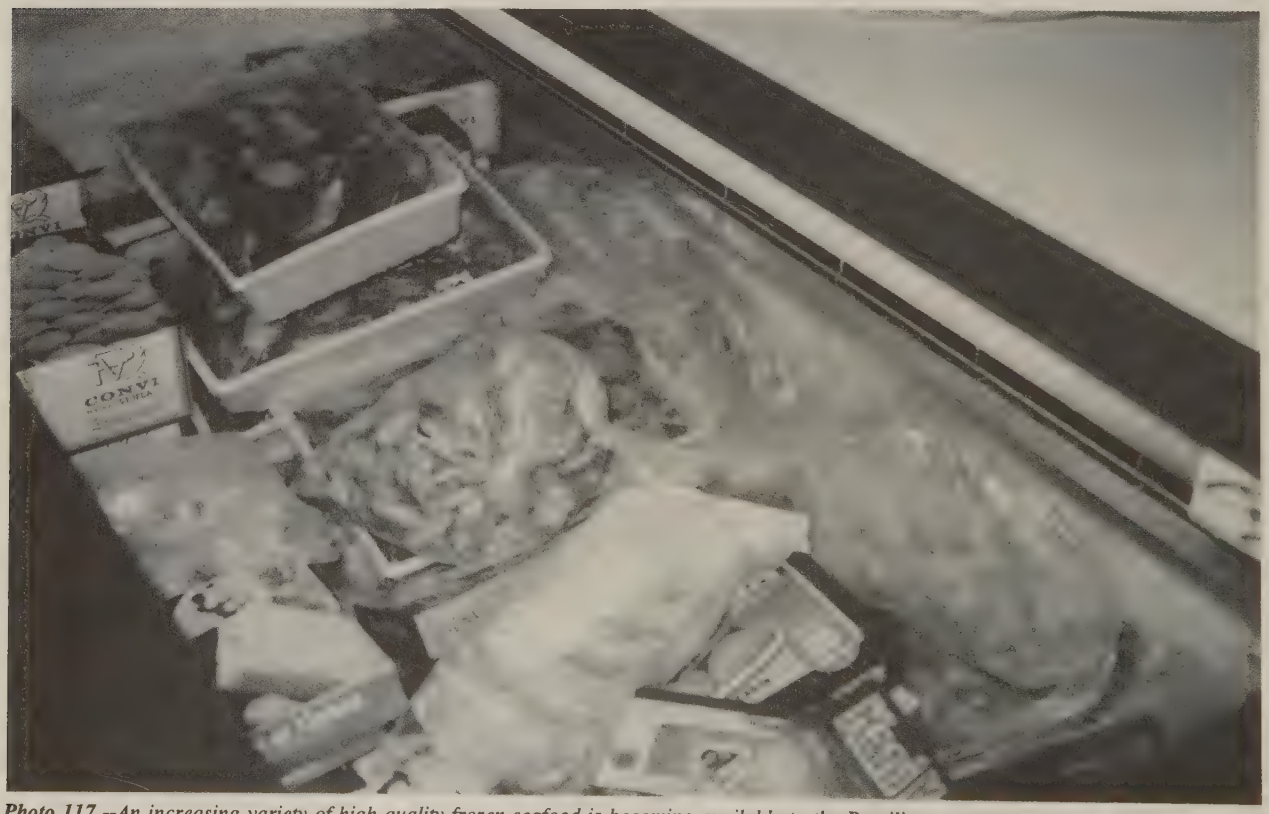


Photo 117.--An increasing variety of high-quality frozen seafood is becoming available to the Brazilian consumer. Dennis Weidner

B. Processing

Swordfish processing in Brazil has been minimal and takes place almost entirely at sea. Companies in 1998 began expanding value added processing for the domestic market. The 1999 fall of he real, however, may impair such efforts because companies will be able to earn much more from export sales of unprocessed trunks.

The swordfish catch upon being boated is headed and gutted and the trunks stored on ice in the hold. Trips should be limited to about 15 days, but some are longer. The fish taken in the first few sets on these longer trips will obviously be of lesser quality. The sharks and billfish are treated in the same way, except that the sharks are finned and the valuable fins strung up to dry.[409] The tunas are left whole. Most of the swordfish and other longline catch is sold as trunks with this minimal processing where it is landed, without any further value-added processing.

Photo 118.--Discussing the purchase of the load of shark fins. Shark fins are dried at sea and are an important part of the crew earnings. Dennis Weidner

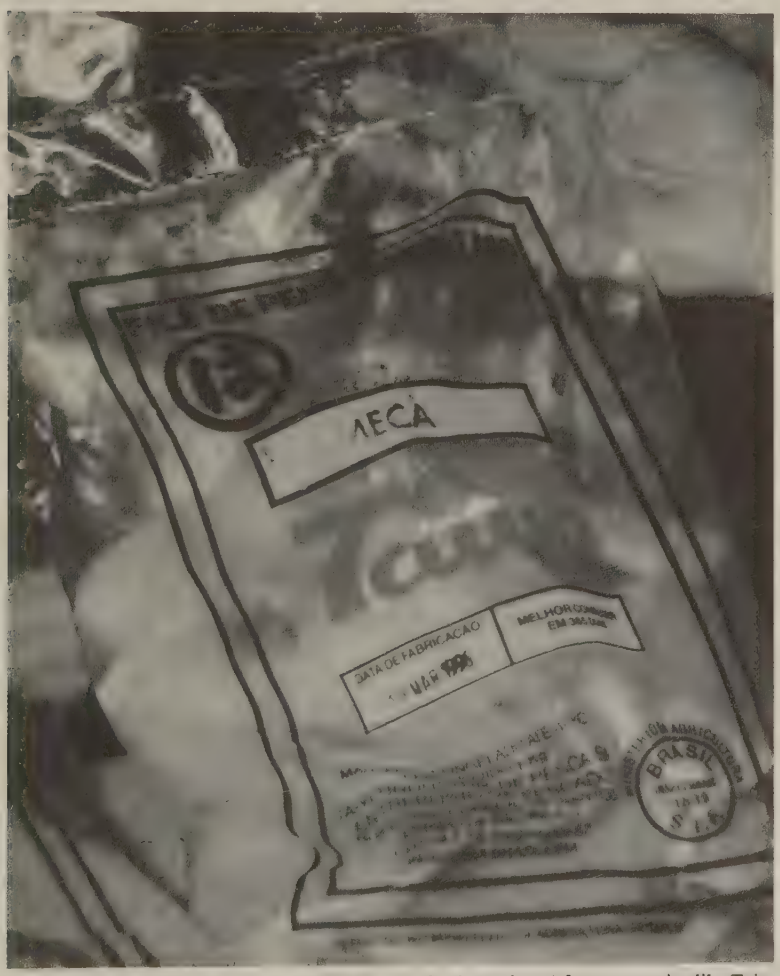


Photo 119.--Most Brazilian swordfish is sold as fresh trunks. A few companies like Taiyo process swordfish for local sales, in this case small frozen fillets. Dennis Weidner

Several Brazilian companies process small quantities of value-added swordfish product. As the products are currently marketed exclusively in the domestic market, the production is limited. Many Brazilians are unfamiliar with swordfish. As the species has commanded a high price in international markets, there has been little incentive for Brazilian companies to develop the domestic market. Basically they used damaged or small fish which could not be exported as raw material for value-added processing in Brazil.

The Brazilian approach to the country's domestic market appeared to begin changing in 1998. Brazilian companies were faced with a difficult situation in which there earnings were being adversely affected by two

developments. First falling international prices for swordfish lowered earnings (appendices G2c and G2e3). Second, the over-valuation of the Brazilian real (the national currency) through 1998 also adversely affects earnings of exporting companies.[410]

Brazilian companies to compensate for falling export earnings began to more aggressively target the domestic market. This required value-added product. This the falling export earnings stimulated the domestic production of value added product. Companies began actual in-store promotions with engaging displays. Several companies are expanding production of value-added products and adding new lines.

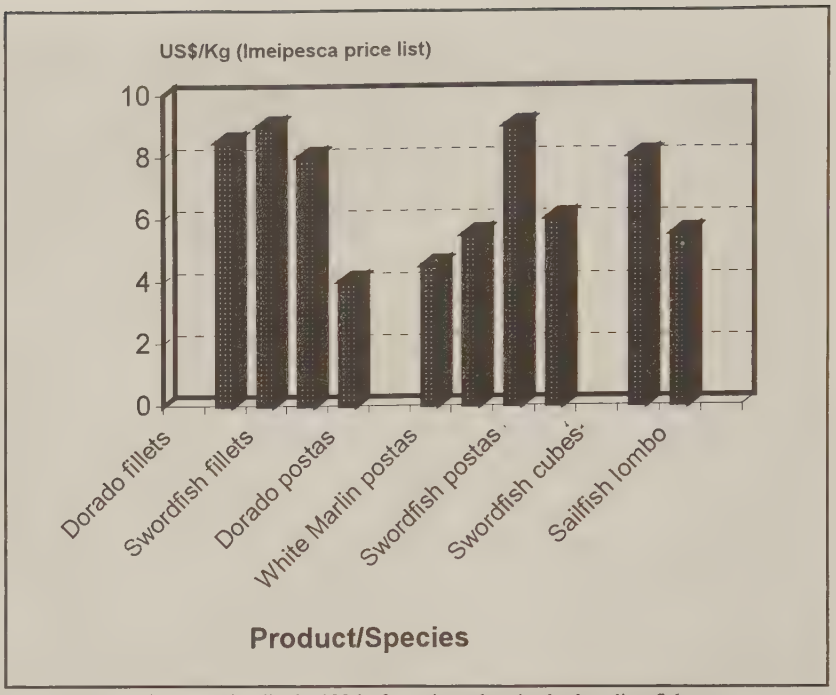


Figure 77.--Imaipesca price list in 1996 of species taken in the longline fishery.

The Brazilian Government's decision in 1999 to float the real may affect efforts to promote domestic sales. The value in reales of export sales has effectively doubled by the decline of the real in foreign currency markets as of February 1999. Thus export sales have become much more lucrative to the fishing companies.

Only a small number of Brazilian companies currently process value-added swordfish products. The overall quantity processed is very limited. The companies and products known to the authors include: **Comércio de Pescados Caiçara** (CPC): This Santos company processes a variety of fishery products to supply its frozen fish store. Much of the production is sold at its modern Santos retail outlet. In previous years, Santos residents would never have bought frozen product as the nearby market offered a wide variety of fresh product. Brazilian consumer preferences are changing and high quality frozen product in Brazil can now compete with fresh product. The store owner reports expanding sales of frozen product to his retail customers who prefer the clean, sanitary store to the fresh fish market. The company also reports that some of the major clients are local restaurants, which like the retail customers value the convenience

Photo 120.--Many of the fish landed by the longliners are too large for one person to handle. Dennis Weidner

Photo 121.--The catch handled at Norte Pesca is thoroughly washed in sanitary conditions before being processed as fresh and frozen product. Dennis Weidner

of frozen product. CPC frozen swordfish products include chunks and small fillet-like cuts. The pieces are individually frozen and sold in plastic bags. The company also produces frozen shark products.[411] The owner sold the company in 1997 and the name has changed to New Symbol.

Imaipesca: One Santos company (Imaipesca), associated with Taiyo, processes small quantities of swordfish and larger quantities of other species taken in the longline fishery (tunas, billfish, and shark), mostly for the large Japanese population in the São Paulo area. Products include fillets (dorado, shark, and swordfish), postas (swordfish, white and blue marlin, albacore, shark, and dolphin), cubes/chunks (swordfish and shark), and lomos (swordfish, sailfish, and albacore) (appendix F1).[412] The frozen products are sold to a variety of retail outlets including supermarkets, but the main customers are a variety of institutional purchasers (hospitals, factories, etc.).[413]

New Symbol: The new owner of Comércio de Pescados Caçara has renamed the company, but the products available have not changed.

Norte Pesca: Norte Pesca in 1998 launched a new product line of frozen swordfish steaks in vacuum bags for sale through Brazilian supermarkets. The company keeps a small frozen swordfish for display purposes. It is used in a variety of in-store marketing promotions. Norte Pesca has also printed brochures to help introduce swordfish to the Brazilian consumer. The company is studying the possibility of future additional products, such as cubes for barbecuing.[414]

Photo 122.–Brazilian costumers at a fresh fish stand. Most fish is still processed as fresh product in Brazil. Dennis Weidner

in other Latin American countries (appendices G2e1-2). There are limitations to the "apparent" price data used by the authors. The reader should note that the price data used in this report is not actual price information, but rather "apparent" prices. i.e. price data derived from the trade data reported by the U.S. Bureau of the Census. Thus it reflects estimated consignment prices which can vary somewhat from the final prices received by the Brazilian exporters.[416] Discussions with Brazilian companies and U.S. exporters, however, suggest that the estimated "apparent" prices are a reasonably accurate reflection of the final actual prices. One exporter indicates that "consignment" prices are a special problem for Brazilian exporters because so many importers appear concerned about the quality of Brazilian product. The exporter was particularly concerned as he felt the prices for the high quality product shipped by his company (Norte Pesca) was being adversely affected by the poor quality product being shipped by competitors.[417]

C. Product quality

The question of product quality is a key factor in the Brazilian swordfish fishery. Several U.S. importers indicated that much of the swordfish originating from Brazil is poor quality fish. Some believe that it is primarily the fish taken in the warm tropical water of the northeast. Several tropical countries in Latin America, however, get much better prices for their swordfish exports than do Brazilian exporters (appendices G2e1-2). Several U.S. companies are less willing to identify the problem as being one of warm-water fish taken off the northeast. Norte Pesca reports, for example, that U.S. importers describe their shipments as of "wonderful quality," better than fish taken off southern Brazil.[415]

1. Quality problems

The authors know of no study demonstrating that some Brazilian swordfish is of lesser quality than product originating in other Latin American countries. Nor has there been a study identifying and assessing the problems encountered with Brazilian swordfish shipments. It does appear, however, that at least some Brazilian shipments are of inferior quality. This conclusion is based on anecdotal comments from a variety of U.S. importers. It is also based on the very substantial price differences on the U.S. market between Brazilian swordfish and swordfish originating

The authors believe that there are substantial quality problems with some Brazilian swordfish shipments. Some Brazilian sources dispute the charges of poor quality, but others agree that some shipments are poor quality product. The substantial price difference between Brazilian and other Latin American swordfish (appendices G2e1-2) over such a long time period, buttressed with comments by U.S. importers, strongly suggests that there are significant quality problems. The authors stress that this does not mean all fish coming from Brazil is of inferior quality. It probably does mean, however, that enough low-quality fish comes from Brazil that it has affected the perceptions of importers.[418]

There appears to be a variety of product quality problems associated with Brazilian swordfish exports. The authors know of no study identifying and assessing the problems encountered. Discussions with fishermen

Photo 123.-Ice deliveries to the Santos Terminal Pesquero where it is "shaved" for use in fishing vessels. Dennis Weidner

with blood vessels which deliver the protein myoglobin in large quantities, accounting for the darker color. Myoglobin is also delivered to the white muscle areas, but because the dark muscle areas contain more blood, myoglobin, and compounds such as trimethyl amine oxide, red or dark-colored flesh tastes different than does white flesh.[419]

2. Causes

The problem of poor quality fish in Brazil does not appear to be primarily one of inadequate handling or processing standards. Some fisheries and processing companies have handling procedures which could be improved, but the overall standard in the Brazilian fisheries is not dissimilar to operations elsewhere in Latin America. Two of the major deficiencies observed by the author in two visits to Brazil (1996 and 1998) were the inadequate use of ice to keep fish chilled, and storing swordfish and tuna mixed with sharks in the vessel holds. The poor quality of the Brazilian fish, however, appears to relate more to natural conditions of the fish rather than handling--although the lack of a detailed assessment makes such a conclusion only

and importers, however, suggest that some of the principal problems are: soft flesh; low fat content; small-sized fish; large dark blood lines; and parasite infestation. Some of these factors affect the texture and taste of the fish. Soft flesh is a major negative problem. Parasite infestation can affect only parts of a trunk. Large bloodlines is partially an aesthetic problem, but a large area of dark colored flesh can also affect the taste. The dark-colored area are more richly supplied

Photo 124.--A small quantity of swordfish is marketed frozen in the Brazilian market. Note the prominent brown blood line. Dennis Weidner

preliminary at this time.

A variety of factors affects the quality of Brazilian swordfish. Most of these problems are naturally occurring and not due to handling deficiencies. Factors such as fat content, area of discolored bloodline, size of individuals, and extent of parasite infestation are naturally occurring and not affected by handling. Soft flesh could be related to both natural condition as well as handling procedures. Both Brazilian and foreign fishermen have reported all or some of these problems.[420] As many of the problems are primarily naturally occurring and not exclusive to domestic fishermen, possible poor handling by Brazilian fishermen is probably not the key factor.

***Photo 125.**--Various parasites affect swordfish and other species taken in the longline fishery. Dennis Weidner*

Photo 126.--Swordfish at Santos are landed, washed, and immediately loaded on waiting trucks for delivering to processing plants where they are packed for air shipment. Dennis Weidner

Photo 127.--The swordfish trunk has been damaged by a cookie cutter shark, note characteristic round bite. The meat is mostly undamaged and will probably be marketed domestically. Dennis Weidner

The reason these problems appear to occur off Brazil to such an extent that market value is impaired is not well understood. Both natural and fishery-related causes appear to be involved in the quality problem. Natural causes appear to be the most significant factors, but the authors stress there has been no detailed study conducted to substantiate this. The authors have identified several factors that could be affecting the quality of Brazilian swordfish. The following list is presented to help assess the problem off Brazil, but is not meant to be a complete inventory of the problem.

A variety of natural causes appear to be impairing the quality of some of the fish taken off Brazil. Many observers are convinced that water temperatures are the key factor. It may eventually be proved that another cause of poor quality fish is that much of the Brazilian catch, especially off the northeast, are fish in spawning condition. As a result, many fish are in a depleted state and this may affect the quality of the flesh. The relatively deep waters they frequent may be another important factor.

Spawning: One possible cause of poor quality could be that large numbers of fish are taken in spawning condition. Spanish researchers have demonstrated the presence of large number of males off Brazil (figure 20). The presence of males in some areas is 4 or 5 times higher than normal.[421] The most likely reason for this concentration of males is the presence of females in spawning condition. The energy devoted to spawning could affect the condition of the fish, which could explain the low quality flesh and poor fat content. The northeastern coast and offshore areas do appear to be swordfish spawning grounds (figures 18-20). Spawning in many fish causes the characteristics of the fish to deteriorate. The authors know of no study examining the relationship between spawning and the market quality of swordfish although this may be an important factor. Notably the U.S. fishery heavily targets the Gulf of Mexico and southeastern coast. This is an area of intensive swordfish spawning, but the market price of the fish taken suggests there is no major impact on quality.[422]

Unknown factors: The extensive area of discolored flesh because of the large blood lines is largely unexplained. The large bloodline is a natural factor, not the result of poor handling. It could be caused by feeding behavior or varieties in prey items. Biologists explain that large bloodlines in oceanic pelagics is due to the dark or red muscle needed to generate sustained energy. White muscle, on the other hand, reflects the need to generate sharp bursts of energy.[423] The muscle structure thus could relate to feeding behavior or migratory patterns. A large bloodline may also be associated with some behavior affecting thermo-

Photo 128.–Handling procedures vary in Brazil. Swordfish for export is usually loaded directly onto trucks. This shipment has been iced awaiting domestic distribution. Dennis Weidner

regulation. The warm sea surface temperatures or pursuing prey at great depths, for example, could be a factor. The authors note the presence of the deep water Brazil Basin off the coast of Brazil, especially off the northeastern coast. It is certainly a factor which should be assessed. The actual cause of large numbers of swordfish with expanded bloodlines off Brazil, however, is unknown at this time.

Water Temperature: The warm water temperature off northeast Brazil may be a factor affecting product quality. The authors note, however, that other Latin American countries fish in warm water (Costa Rica, Ecuador, Mexico, Venezuela, and others) and their product sells at much higher prices than does the Brazilian swordfish (appendices G2e1-2). This is a factor which could affect the condition of the fish. Fish grow more rapidly in warm water and such fish may not have as firm a flesh as fish growing more slowly in colder waters. There are also fishery-related elements. Fish hooked soon after the line is set spend several hours in the warm water before they are boated and the quality of the flesh would begin to deteriorate during this period.

Parasites: There are reports of heavy parasite infestation in some catches. The authors, however, have no information quantifying the problem in Brazil or identifying a specific parasite. Nor is there information comparing the extent of the problem off Brazil with the situation in other Latin American fisheries. One Brazilian source estimates parasites affecting the market value of the fish are present in roughly 5 percent of the catch.[424]

Shark damage: Some of the hooked fish are attacked by sharks. Sharks can damage the catch before it can be harvested. A wide variety of species are involved (appendix I1). Some times an entire carcass is virtually shredded. Other sharks cause only minor damage. One of the most common problems is the cookie cutter shark, which leaves a distinctive circular bite. No data is available on differences in parasite infection or shark damage by Brazilian regions or how Brazil compares with other countries.

Several fishery-related factors also affect product quality.

Fishing Practices: The use of especially long mainlines with a large number of hooks can impair fish quality. The previous Japanese-style multi-species fishery deployed longer lines and larger numbers of hooks than the new U.S-style monofilament fishery. This meant it took a long time to take in the line, leaving hooked fish in the water longer. This could have an especially serious impact on product quality in the warm tropical waters off the northeast coast (figures 31-35).[425] In addition, the larger number of sharks and other species brought aboard provides less time to carefully dress the swordfish and other high-value species. This is becoming less of a problem as many fishermen have shifted to U.S-style monofilament operations, using fewer hooks and targeting primarily swordfish.

Handling Problems: Some Brazilian companies could improve handling practices. Improved handling is critical for Brazil, especially in the northeastern fishery conducted in tropical waters. The tropical climate means that handling deficiencies tolerable in temperate climates can serious impair product quality. One key factor is how long hooked fish are left in warm. tropical water. The fish taken in the traditional Japanese-style fishery were often stowed mixed (tunas, swordfish, billfish, and other species mixed together with sharks.) The high urea content of the sharks, even after bleeding, may impair product quality--especially if large numbers of sharks are retained. In addition, the swordfish cannot be quickly unloaded as soon as the boat docks because the catch is all mixed. This delays the unloading of the swordfish and its transportation to the airport. Meanwhile, the already loaded fish could sit exposed to warm temperatures for several hours awaiting sale and boxing. Some fishermen report that these delays in unloading their catch affect product quality. The fish is about 0°C when the boat arrives in port. Once the fish is unloaded, it can warm to 0.5°C or more per hour. If a fish is left unchilled for 2-3 hours it can warm 1-2°C or even more. This adversity affects the quality.[426] This can be a special problem in several ports the longliners are now using where the vessels are not unloaded as quickly as is usually the case in Santos.[427]

Operating costs: Improved handling is not just a matter of knowing the proper procedures. There ia an economic cost associated with improved handling. Better handling can allow the fishermen to help maintain fish quality for longer periods, but it is costly in terms of equipment, training, labor, and other factors.

Experience: Another problem may relate to the expansion of the fishery out of northeastern ports. The northeast ports like Natal are less well-equipped to support commercial fishing vessels. This has led to delays in unloading vessels, which affect product quality. One of the major problems in the northeast is that there are more limited European or Japanese communities there. These are the population sectors that have played a large role in developing the commercial fishery off southern Brazil, especially the longline fishery. Thus operations out of northeastern ports have not had experienced talents to draw upon.[428]

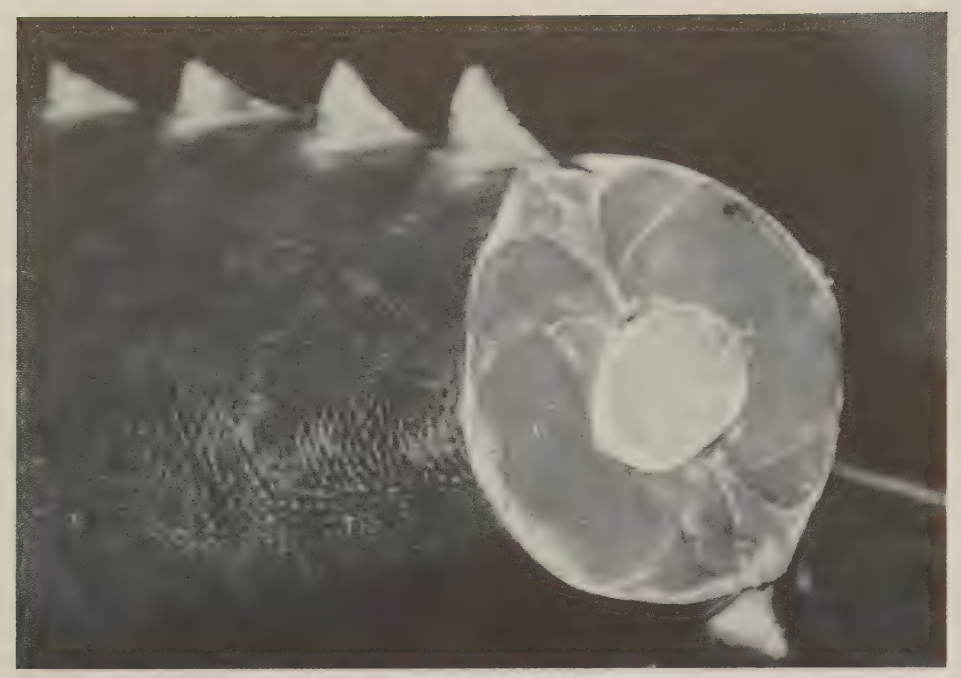


Photo 129.--The tail section of tunas are cut to evaluate quality, especially the fat content--a key factor. Unlike swordfish, there are international standards and grades for tunas. D. Weidner

3. Industry response

Brazilian companies are acutely aware of the quality problems and the impact on the prices that Brazilian product commands in export markets, especially the critical United States markets. Many companies have differing views on what the specific problems are and how important they are. The issue of bloodline color is, for example, a relatively recent issue. Many fishermen see it as just another "ploy" by buyers to lower prices paid for the catch.[429] Other Brazilian companies are convinced that there are serious problems that need to be addressed. Opinion also varies as to what region is most affected. Some believe it is primarily fish taken in the northeastern fishery.[430] The lack of definition of the problem and agreement on the major problems, relative importance, causes, and the areas most affected has made it very difficult for the industry to address the quality problem.

Brazilian company representatives have been discussing the problem, but there is yet no industry consensus on precisely what actions to take. Some companies would like to see quality standards set and an industry inspection program established to award a quality seal for high- quality fish.[431] Discussions have been conducted within the Conselho Nacional de Entidades da Pesca (CNEP). One of the problems, however, is that there is substantial dissension among the companies involved on just how to set the standards for any such quality seal. Companies want to make sure the standards are set so the fish they harvest will receive a quality seal.

Brazil like other countries is in the process of implementing a Hazard Analysis Critical Control Point (HACCP) program. The program has been adopted primarily because the United States and the European Union have required such programs, and companies desiring to export to these markets must have comparable programs. Brazil's HACCP program is administered by the Ministry of Agriculture which in mid-1998 was conducting on-site inspections to evaluate individual companies' HACCP programs. The major companies currently exporting to the United States report that these inspections have been positive and their HACCP programs have been well received, although in many cases the inspectors have made helpful suggestions for improvements. Some of the countries have hired foreign HACCP specialists as well as arranged for U.S. and E.U. training for their in-house quality-control specialists.

The question of swordfish quality standards may be an especially difficult one for the Brazilians to address. Some industry observers believe that what is needed is a quality/grade based system, much like the code that is used on an international basis to separate tunas. Though not perfect, the grades are a good indicator of quality and the system allows product to flow more correctly to the appropriate market. Such a system needs to be established by the importing country. Some belie that it is unlikely that U.S. dealers will set up such a system since they have an incentive to the contrary. As it now stands, some dealers buy cheap, lower quality imported product and sell it at the same price as domestic product.

XI. Organizations

A. Industry groups

1. Trade associates

Brazil's fishing industry is highly regional. There is one principal national trade fisheries organization, the Conselho Nacional de Entidades da Pesca/Federação dos Sindicatos e Associacão da Productores e Distribuidores de Pescados, in Brasil (Compe/Fapesc). Because of the country's regional bias, however, Compe/Fapesc is not as strong as trade groups in several other Latin American countries. Many of the member state affiliates, such as the Sindicato da Industria da Pesca no Estado de Sao Paulo (SIPESP) are particularly important. Coupe/Fapesc does not have a group or committee addressing the needs of the longline fishery, although several members are meeting informally to discuss, among other matters, how to improve the image of Brazilian swordfish on the world market. Members report that there is still a wide diversity of opinion on possible actions and, as a result, no consensus has emerged.[432]

2. Companies

Brazilian companies have been active in tuna fisheries, primarily live-bait and purse seining for skipjack. Many also participate in the longline fishery for tuna and swordfish. Other companies handle, process, or market the catch.

Alcyon: This Santos-based company operated tuna vessels during the 1970s.[433] The primary activity was canning.

Alvarenga Com. e Ind. de Pesca: This Espirito Santo fisheries company has occasionally exported some swordfish (appendix F2b). It does not, however, have a U.S. Food and Drug Administration (FDA) exemption from the automatic detention of swordfish alert. Thus company shipments of swordfish will be delayed at least two days for testing at U.S. ports of entry.

Amaral: This is one of the major companies operating longliners for swordfish from Itajaí. The company was active in 1998 and 1999, but the authors have no further details.

Bamar do Brazil: This Santos firm exports swordfish and other seafood. FDA has approved an exemption to the automatic detention alert for swordfish (appendix F2a).

Bigmar: This company deployed the live-bait tuna vessel *Tunamar* in 1993. The vessel sank with considerable loss of life on its first trip.[434]

Cabedelo Pesca: This company is located at the port of Cabedelo, near João Pessoa, Paraíba. In 1996, Cabedelo Pesca leased two Spanish longliners (*Cosmos* and an unknown vessel). Operations had expanded by 1998 to two Portuguese, six Spanish, and six Taiwanese longliners. The company is rather secretive about its operations and discourages Brazilian scientists from sampling the catch as permitted by Brazilian regulations. The swordfish catch is landed frozen and shipped in containers from the Cabedelo cargo port. The product is marketed as frozen product in Spain. Cabedelo Pesca retains the tuna catch and is sold fresh to Japanese restaurants. Some of the fish catch is frozen and sold in supermarkets. The company is owned by a Spaniard, Jesus Zapata, and a Brazilian partner. The company in 1998 was operating three commercial longliners, *Cosmos* (80-GRT), *Sidenel* (120-GRT), and *Corvisa Tres* (150-GRT). They also have a license for a fourth longliner, but have not yet purchased the vessel.

Photo 130.--Sr. Yemel, the energetic owner of the CPC frozen fish store, discussing his products with Brazilian fishery scientist Dr. Amorim. Dennis Weidner

Photo 131.--The "Dalia" has been deployed by EMPESCA out of Natal. The company is constructing two purpose-built longliners in Belem. Dennis Weidner

quality frozen fish, consisting of both domestic and imported product. The domestic products include a variety of species taken by the longline fishery. Swordfish products include chunks and small portions of fillets. They also handle tuna and shark. The fish is flash-frozen at the company's modern plant and packed as individual pieces in plastic bags. His clientele includes both restaurants and retail consumers, mostly middle-class Brazilians who are increasingly turning to frozen fish because of the convenience.[436] The company was sold in 1997 and now operates as New Symbol Comercio Exportador.

Cia. de Pesca do Atlântico: This company commenced tuna operations in 1976, deploying three longliners, the *Oyang 28, 38,* and *83*. The vessels were deployed about 190 km off the coast of Sergipe. The company reported catches of albacore, yellowfin, bigeye, marlin, and mako sharks.[435]

Com. e Ind. de Pescados Kowalski: This well-established Itajaí fishing company operates 10 fishing boats, four of which are longliners. The company has played an important role in the expansion of the Itajaí fishing port during recent years. Kowalski is one of the principal companies operating longliners out of Itajaí. Some industry sources consider the company one of the more efficient operations to enter the longline fishery in recent years. Kowalski exports swordfish and other seafood. FDA approved an exemption to the automatic detention alert for swordfish on September 30, 1996 (appendix F2a). The company also handles fish landed by the longliners leased from Taiwanese companies.

Comercial de Pescados Villa: This firm exports swordfish and other seafood. FDA approved an exemption to the automatic detention alert for swordfish on August 20, 1996 (appendix F2a).

Comércio de Pescados Caiçara: This Santos-based company during the 1980s and 1990s prepared the fresh swordfish catch of the longline fleet for export to the United States. The already dressed swordfish are cleaned, packed in dry ice or gelpacks, and delivered to the Sao Paulo airport for direct shipment to Miami. Recently the company's energetic owner, Elias Yemal, opened a modern, frozen retail fish store offering high

Cooperativa de Pesca Nipo Brasileira: This group was active in arranging the leasing of Japanese tuna vessels during the 1970s.[437] It primarily worked with the Ono brothers. The Cooperative also operated a cannery. It is an association of vessel owners. The names suggests a group of Japanese and Brazilians. The cooperative was actually founded by a Spaniard who hoped to attract Japanese members. Currently the cooperative is no longer involved with longline fisheries and works primarily with shrimp and finfish trawlers. The cooperative's members are the boat owners and it has extensive facilities in the port of Santos.

EMPESCA: The established Natal (Rio Grande do Norte) company handles lobster and a variety of other species. It began operating an older vessel (*The Dalia*) in 1998, but hopes to deploy two new longlines it is purchasing from a Belem shipyard. The company has pursued a different strategy than most other Brazilian companies that have mostly purchased older vessels, both longliners or other vessels that can be re-rigged for longlining. EMPESCA is investing in very expensive, new, purpose-built longliners (industry sources estimate that a used vessel could be adapted for the longline fishery at a tenth of the cost of purchasing a new vessel). EMPESCA appears to have been influenced by Japanese fishermen and their new vessels include expensive freezing equipment like Japanese distant-water vessels. This differs from most Brazilian longliners, which have ice holds. The new vessels will

Photo 132.--FEMEPE is an important distributer of fresh fish in Brazil. Dennis Weidner

other seafood, especially snapper. FDA approved an exemption to the automatic detention alert for swordfish on February 4, 1992 (appendix F2a).

FEMEPE: This is one of Brazil's largest fishing companies. It operates three processing plants (freezing and canning), cold stores, and a 20-vessel fleet (pelagic and trawl). It employs hundreds of workers and operates a large fleet of trucks for local marketing. The company acquired a tuna vessel with freezer capacity (160 tons) in 1991. The principal products handled are canned sardines and tuna, fresh and frozen demersal and pelagic species, and frozen shrimp, mostly for the domestic market.[438]

Funelli: This Rio company, which markets fresh fish, had plans to enter the longline fishery and reportedly bought two big Japanese longliners in 1996. The company has since sold them.

Imaipesca: Imaipesca was founded by Japanese-Brazilians and through families ties is connected with Taiyo's Brazilian subsidiary. Imaipesca is currently

not be ready until late 1998 or early 1999 so EMPESCA continued 1998 operations with an older vessel designed for longlining--the *Dalia*. The company has experienced many difficulties with the vessel, in part because of mechanical problems and in part because of their limited familiarity with longline operations. The company appears to be making a major financial commitment to the fishery. As it has no experience in longlining, it is offering high wages to experienced Natal fishermen and has contracted with a U.S. fishing master.

Estaleiro Naval San Pedro: This Itajaí operation exports swordfish. It is one of the major companies operating longliners and handling swordfish at the port. FDA approved an exemption to the automatic detention alert for swordfish on November 3, 1997 (appendix F2a). They may be handling fish landed by the leased Taiwanese longliners. The name suggests it may be a company operated by the Brazilian Navy.

Exportadora Pargo: This Santa Ana firm exports swordfish and

Photo 133.--Imaipesca is one of the primary Santos companies involved in handling, processing, and marketing the longline catch. Dennis Weidner

Photo 134.--Roberto Imai at Imaipesca closely supervises the handling and weighing of the longline catch that his company markets. Dennis Weidner

managed by the son of the manager of Taiyo. Imaipesca is one of the principal companies involved in the Brazilian tuna/swordfish longline fishery. The company operated one longliner during the 1970s.[439] It expanded its fleet during the 1980s and has also contracted with foreign, mostly Japanese, vessel owners to lease additional longliners. The company in 1996 operated eight trawlers, two seiners, and three longliners (*Imaipesca*, *Kaiko Maru 16*, and *Taihei Maru 3)* (appendix A2C3) It addition, they leased two Barbados-flag longliners (*Colleen Cheramie* and *King of Kings*).[440] Imaipesca supplies its catch to Taiyo for processing as frozen product for the domestic market.[441] The company has for years used Japanese fishing methods and employed immigrant Japanese captains. The recent success of American-style methods has caused the company to purchase new gear, re-rigging the vessels with monofilament line, and to modify fishing methods. The re-rigged vessels are reportedly deployed further off the coast, out as far as 35°E. Imaipesca re-rigged the *Taihei Maru 3* in October 1995, with imported U.S. gear. They later re-rigged the *Kaiko Maru 16* with locally produced gear, but experienced some problems with it. Company officials reported in 1996 that the results of the American-style methods are not fully assessed. At the time we spoke, the *Taihei Maru 3* had only been operating with the U.S. gear for 6 months. Despite the limited period, Company officials were clearly impressed with the results and have since decided to fully commit to U.S.-style monofilament. The company's 1995 swordfish catch was 170 t, but in only 4 months of 1996 they landed 120 t of swordfish. They noted that while the American methods were producing higher yields and larger fish, operating costs were also higher. The company is trying to limit fishing costs and plans to use fewer light sticks with its sets as a means of reducing expenses. Company officials are also concerned about the possible impact of the U.S. fishing methods which specifically target swordfish, on stocks. They point out that swordfish is one of the few species

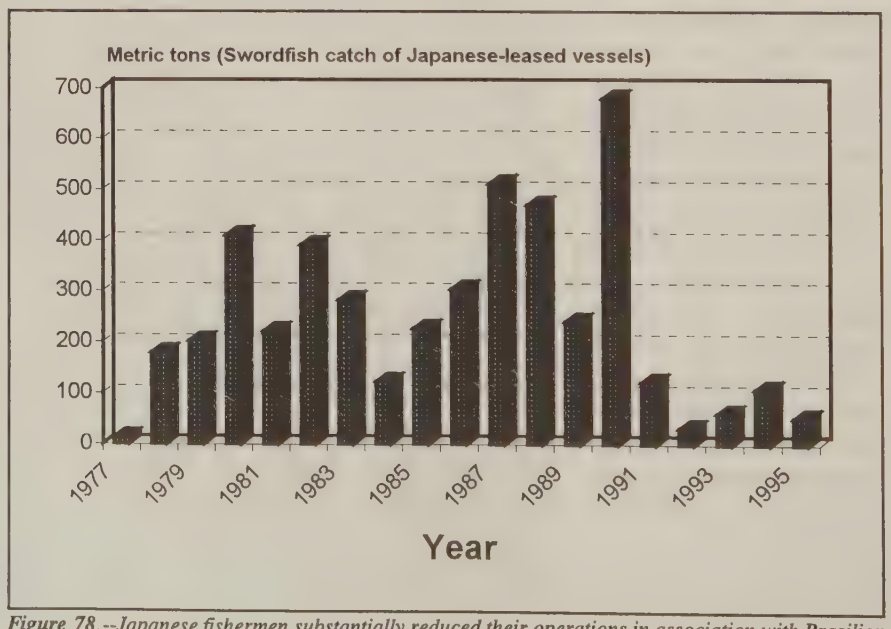


Figure 78.--Japanese fishermen substantially reduced their operations in association with Brazilian companies after 1990.

the longliners target that had not yet experienced declining catch-per-unit effort (CPUE). Most of the swordfish catch is exported to the United States. This Santos firm exports swordfish and other seafood. FDA approved an exemption to the automatic detention alert for swordfish on May 23, 1997 (appendix F2a). The company sells much of the non-swordfish output of the longline fleet in the domestic market, targeting the Japanese-Brazilian community. Only the swordfish is mostly exported, primarily to the United States.[442] The 1998 decline in U.S. swordfish prices, however, is causing Imaipesca to reassess its marketing strategy. Imaipesca, like several other Brazilian longline companies, is reporting a serious problem with killer whales. Additionally, Imaipesca and other companies founded by Japanese immigrants is undergoing substantial change. A new generation born and raised in Brazil is now managing the company. In addition, many of the Japanese captains who have directed fishing operations are being gradually replaced by Brazilian captains.

ITA Fish: This company operates longliners. Operations are normally conducted out of Santos, but during the first half of 1998, the company operated off the northeast coast out of Natal. Results were discouraging. The swordfish landed were of poor quality. About half the swordfish had very large dark bloodlines. In addition, the port facilities were poorly organized. Loading ice takes about 2 hours in Santos, but might take 3 days in Natal. It also proved much more difficult to obtain needed spare parts. One company official vowed, "I'll never return to the northeast."[443]

Itasul: This company went bankrupt, but Maximo Marcelino leased the plant to operate one or two longliners in 1997. One was the *Don Bosque*.

Jen-Mar Importaço & Exportaço: This São Paulo import/export company has occasionally exported some swordfish (appendix F2b). It does not, however, have a FDA exemption from the automatic detention of swordfish alert. Thus company shipments of swordfish will be delayed at least two days for testing at the U.S. port of entry.

Kawai Suisan: This Santos-based company is one of the principal Brazilian companies operating tuna longliners. Kaiwa began operations along the northern coast and later initiated operations out of Santos. The company has operated longliners since the 1970s and has also leased foreign longliners. Currently they operate ten longliners: six Brazilian vessels (*Tooshin Maru 101-106*) and four leased vessels (*Atlantic Core, Jer Dos, Julius*, and *Sea Wolf*) with Honduran/Panamanian flags (appendix A2c3).[444] Kaiwa is working with a U.S. group in Montevideo (Trimur) to arrange for the leased vessels. Kaiwa regularly made large monthly shipments of fresh swordfish to the United States.[445] The also market bigeye in Japan and albacore in Spain and France. Kaiwa has given some consideration to freezing some of the catch, but does not believe it had the technical capability to produce a quality product. Despite the fact that Kaiwa is one of the largest longline companies in Brazil, there was not even a small sign at the entrance. Kaiwa officials said that this is to avoid attracting robbers and because the company does not market its product domestically and has no reason to publicize itself locally. The company was founded by a Japanese immigrant and many of the employees are Japanese-Brazilians. It has, however, lost contact with Japanese companies. As with other Brazilian longline companies, much of the fisheries technology was introduced by Japanese captains in the 1960s and 1970s. Many of the captains have since settled in Brazil. As a result, the fishing gear and technology was dated. The company's owner, Ricardo O. Komori, during the early 1990s spent two years in the United States learning about U.S. fishing methods. He introduced a variety of innovations into the company's

Photo 135.--Office and warehouse of Kawai Suisan in Santos. Notice that there is no company sign. Dennis Weidner

fishing operations during the mid-1990s. These included innovations such as the use of monofilament line. Komori has also introduced innovations of his own. The company's Japanese captains were amazed at the efficiency of the new gear and fishing methods. The gear was not only effective in increasing swordfish catches, but also bigeye. The contracts with the foreign boats are an important part of the company's fishing strategies. Their Brazilian vessels were not equipped with sophisticated instruments to detect water temperatures and to help find areas with the appropriate temperatures. They maintain close contact with the *Sea Wolf*, which was equipped with sophisticated instrumentation.[446] Kaiwa wants to increase its use of available satellite telemetry, which is one reason it decided to lease the *Julius* because it is equipped with a computer to download satellite data. Kaiwa markets the catch, but gives the individual vessel captains considerable flexibility in determining where to fish and what fishing strategies to use. Kawai in early 1996 had only Japanese and U.S. captains, but two experienced Brazilians are in line for promotions in the near future. The company advises its captains as to prevailing market conditions and prices, but the fishing decisions are made by the captains. The company reports that the U.S. captains generally target swordfish, while their Japanese captains are interested in other species (such as bigeye), as well as swordfish. Kaiwa initiated a major expansion program in 1995. The firm reportedly invested $2 million in a new venture in the state of Espiritu Santo. As a result, in early 1996 the company was experiencing serious financial problems and was unable to pay its fishermen for the past one to three trips. The fishermen in mid-April 1996, staged a short strike in protest as they were having great difficulty paying their bills.[447] The union leaders, however, were trying to arrange an accommodation with the company as they had no desire to bankrupt it.[448] Kaiwa, like other Brazilian companies, was reporting increasing problems with killer whales and false killer whales.[449] Santos industry sources indicate that because of a variety of management problems unrelated to the fishery, Kaiwa was forced to close in 1997.

Kowalski: See "Com. e. Ind. de Pescado Kowalski.

Leal Santos Alimentos: This company, originally associated with the Ipiranga group, is an important Brazilian company involved in producing food products with operations dating back to 1888. Fishery operations began in the early 1900s. Leal Santos was purchased by a large investment group, the Empresas Petóleo Ipiranga in 1967. The company operates its own fleet of about 50 finfish and shrimp trawlers which target demersal fish (croaker, porgy, weakfish, and shark) and various shrimp species. The company has fishing, processing, and marketing operations in nine Brazilian cities. It also operates two tuna baitboats and cans the catch (mostly skipjack) in its cannery located at the Rio Grande Super Port. The company began leasing Japanese tuna vessels in September 1977, after the Government issued new regulations permitting the leasing of foreign fishing vessels in 1976.[450] Leal Santos pioneered the leasing arrangements. The contracts are relatively standard. Leal Santos helps to finance the fishing trip by paying most of the in-country expenses (except fuel), but then is guaranteed 10 percent of the export revenue (appendix A2e1). The company since 1977 has leased varying numbers of foreign longliners (usually two to six vessels) for operations from its Rio Grande (RGS) processing plant. The company during the 1970s and 1980s only contracted with foreign longliners (mostly Japanese); no Brazilian longliners were ever contracted. Contracts were negotiated with nearly 40 foreign longliners, initially Japanese (appendix A2c3). The company generally leased about two to six foreign longliners

Photo 136.--Most of Brazil's tuna catch is canned. This is the Leal Santos cannery in Rio Grande do Sul. Dennis Weidner

Photo 137.--This New Symbol retail store in Santos offers high-quality frozen product. The owner has his own processing plant. Dennis Weidner

annually. The company began to work with Taiwanese longliners in 1991 and increased the number of longliners licensed to as many as 18 (Japan 2 and Taiwan 16) in 1993. The company leased two Korean longliners in 1994. Leal Santos is interested in continuing to lease the foreign longliners, but the foreign longline fishermen reduced operations from Rio Grande in 1995 to only four vessels (Japan 2 and Taiwan 2) and completely terminated operations in 1996 (appendix A2c2a).[451] The company has group based in Brazil's capital, Brasilia. One local observer speculates that the foreign companies involved in the leasing arrangements may have withdrawn their vessels in 1996 because they were unsure about the credit of the new Leal Santos owners, but many other factors could have been involved.[452]

Mares do Sul: This Santos firm exports swordfish and other seafood. FDA has approved an exemption to the automatic detention alert for swordfish (appendix F2a).

New Symbol Comercio Exportador: This Sao Paulo firm exports a variety of products, including swordfish and other seafood. FDA approved an exemption to the automatic detention alert for swordfish on May 5, 1995 (appendix F2a). New Symbol purchased Comercio de Pescados Caiçara in 1997, and it is now a major supplier of high quality frozen product, including frozen swordfish, to the domestic Santos market.

Norte Pesca: This company is based in Natal, Rio Grande do Norte, but also has a plant in Recife. The company began in 1960 to export lobster tails, one of the first Brazilian companies to do so. Norte Pesca subsequently entered the longline fishery and is now the major northern Brazilian company deploying longliners. The company during 1995 operated three (leased and Brazilian) longliners out of Natal. They have also worked with U.S., Trinidad, and various flag-of-convenience longliners through leasing arrangements. The company also reportedly deploys

Photo 138.--The Norte Pesca Natal plant has a pier. The catch is unloaded and immediately processed without any delay in transporting the catch to a plant. Dennis Weidner

pelagic driftnets.[453] A 1996 report indicates that the company operates two company-owned 16 m and 21 m longliners (*Argus* and *Rio Turi*), and operates in association with five other 15-25 m Brazilian longliners (*Alfa, Rainha do Mar, Namorado, Peixoto Ramos,* and *Pescador*). Norte Pesca leased a U.S. longliner (*Seneca*). The U.S. captain of the Seneca helped introduce U.S.-styles monofilament operations to Norte Pesca, and almost all the old Japanese-style gear had been replaced by 1998.[454] Norte Pesca also works with two Barbados longliners (*King of Kings* and *Colleen Cheramie*). At first, most of the crew were foreigners, but now almost all of the crews are Brazilian, although the captain and engineers ("motoristas") continue to be largely foreign.[455] Norte Pesca had a close working relationship with two Japanese captains, who have since retired. The company now works with Brazilian captains for the Brazilian-flag vessels and foreign captains for the leased vessels. Norte Pesca vessels shift operations seasonally. Different vessels may have somewhat different schedules and the pattern can change somewhat annually. The company during the first half of the year usually fishes off the northeast coast (December-June/July). Fishing on and around the Vitória seamount often occurs during May/June-July. Operations off southern Brazil may be conducted during the third quarter (especially August and September), but in some years, such as in 1998, the fleet stayed in the northeast. The vessels are less active in October and November.[456] Norte Pesca reports that on directed swordfish trips, as much as half the catch is swordfish; the reminder of the catch consists of sharks, tunas, wahoo, and a variety of other species. Seasonally, the company shifts operations to offshore seamonts when the catch is primarily shark and tuna.[457] The swordfish catch is exported as fresh H&G product to the United States. Norte Pesca exports swordfish and other small species (some including tuna and reef fish). They work in association with many artisanal fishermen who deliver product. Norte Pesca's vessels carefully separate the swordfish from the sharks in the holds. As a result, the swordfish can be quickly unloaded as soon as the vessel docks. Norte Pesca has its own pier at Natal and the swordfish are cleaned and boxed with gelpacks within minutes of landing. There are no international flights from Natal so the fish are trucked to Recife for export.[458] Almost all of the swordfish is shipped to the United States, primarily Miami and New York.[459] FDA approved an exemption to the automatic detention alert for swordfish on July 3, 1997. An earlier exemption was issued to "N. Pesca" on April 15, 1997 (appendix F2a). The tuna catch is largely sold for local distribution to Japanese restaurants.[460] The company in 1997, in cooperation with researchers at the Universidade Federal Rural de Pernambuco (UFRPe), adapted gear used by American longliners to the small-boat artisanal fishery (appendix D3b). Innovations such as monofilament, squid bait, and light sticks greatly increased the income of artisanal fishermen using boats of about 12 meters. Norte Pesca handles the marketing of the catch.[461] Norte Pesca has a close working relationship with UFRPe and has sponsored several studies conducted by university researchers. Over 50 papers have been published as a result of this cooperation.

Photo 139.--Norte Pesca workers handling the shark catch of the associated longliners. Dennis Weidner

Ocean Pacific Seafood: This Santos firm produces a variety of products, including swordfish and other seafood. FDA approved an exemption to the automatic detention alert for swordfish on July 3, 1997 (appendix F2a).

Olinda Captura, Industria e Comercio: This Santos firm also produces a variety of products, including swordfish and other seafood. FDA approved an exemption to the automatic detention alert for swordfish on Match 19, 1997 (appendix F2a).

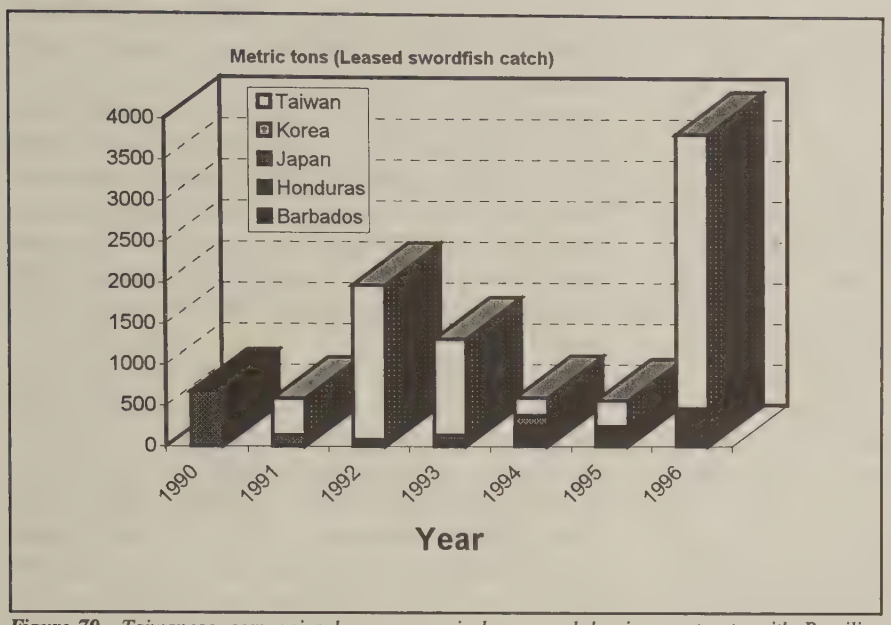


Figure 79.--Taiwanese companies have aggressively pursued leasing contracts with Brazilian companies during the 1990s. Activity declined between 1993 and 1995, but increased in 1996 and 1997.

Ono brothers: This family group operated three longliners beginning in the 1970s. The vessels were deployed from Cabo Frio (Rio de Janeiro state) south to Cabo de Santa Mar (Santa Catarina state).[462] The brothers continued to operate longliners during the 1980s and 1990s (appendix A2c3). They were operating the *Itapuil* and *Itaunal* in 1996.

Otero Pesca: This Recife company had about four to five boats, but in 1998 had reduced operations to one longliner, the *Otero*, which they operated out of Recife. One of the owners is a foreign resident. The company's longliner is one of the few recently constructed, purpose-built longliners on the Brazilian fleet.

Pescal: This Rio Grande (RGS) company is one of the oldest Brazilian fish processing companies. It was established in 1942. Pescal's fish processing plants primarily focus on producing frozen demersal fish and shrimp. The main Rio Grande plant processes about 30 t of raw material annually. The main plant is located in Rio Grande, but there are associated plants in Porto Alegre, São Paulo, and Salvador. While Pescal mostly handles demersal finfish (hake, amberjack, flounder, croaker, sea trout, porgy, pampano, and other species), it does process some sharks, especially liveroil and smooth hound shark ("cação" and "gatuso"). They also process various species of shrimp. Pescal produces a variety of consumer packs, both individually flash-frozen portions in bags and small consumer packs of fillet blocks (mostly 0.5 kg), primarily for the growing domestic Brazilian market. They also export some product (5-20 percent of total production). Most of the exports are demersal finfish shipped to Europe and the United States, but they have had some success with whole frozen croaker in China. The Chinese market, however, is highly variable. The company has expressed an interest in participating in the vessel leasing arrangements carried out by other Brazilian companies. Company officials explained, "We know there is swordfish and tuna in our waters, but there has been no real detailed study of the resource and we haven't figured out how to use it by ourselves yet."[463] Pescal reportedly leased two Japanese longliners during 1979-80, but then

Photo 140.--The "Otero" is one of four to five longliners operated by Otero Pesca. It was the only longliner working out of Recife in 1998. Dennis Weidner

ceased longlining operations for several years.[464] Pescal officials finally decided to attempt another venture. They leased four Taiwanese longliners (*Kao Feng 10, the Kao Fong 3* and *5* and the *Tai Fan 1*) for a one-year contract during 1992-93 (appendix A2c3). Pescal's interest was not only in the earnings from the operations, but also to acquire information and expertise for possible future operations of their own. Pescal officials decided to approach the venture somewhat differently than some of the other companies, although the contractual terms, with one exception (up-front money), was quite similar to the contracts negotiated by the other Brazilian companies (appendix A2e1).[465] Pescal choose Taiwan partners rather than Japanese companies, which had previously provided almost all of the leased longliners. The company also declined to provide any up front money to finance the venture, concluding that such an investment was too risky. The Taiwan vessels were relatively new. Little information is available on the owners of the Taiwanese vessels. The arrangements were made through a Taiwanese resident (Mr. Chang) in Montevideo, Uruguay. Mr. Chang was the same agent helping to contract the Japanese vessels for Leal Santos. Pescal made no efforts to contact the foreign vessel owners directly. The complications as a result of language, legal difficulties, and support required makes it easier and more cost-effective to use the services of Mr. Chang as an agent. The catch was mostly tunas and swordfish. It was frozen whole at sea. Some sharks were retained, but most were discarded. The swordfish and tuna were exported, but some of the shark catch was sold domestically. Pescal was interested in continuing the arrangement, but the Taiwanese vessel owners decided to discontinue the operation in April 1993, after only 6-months of operations, which was allowed under the terms of the contract. The Taiwan fishermen did not explain why they discontinued operations.[466] Press reports indicate that Pescal was forced to lay off 75 percent of its employees in September 1998 and suspend purchases from local fishermen. The company has was forced to deal solely with imported raw material from other MERCOSUR countries, primarily Argentina and Uruguay. High costs in Brazil, in part because of the over-valued currency, forced Pescal to refocus it operations. More than 28 fishing companies in the Rio Grande area have been forced to close entirely.[467]

Quaker: Quaker is the largest tuna canner in Brazil. The company reports recent success at replacing Ecuadorean and Peruvian product on the local market during the 1990s. Quaker spokesmen say that reports of cholera outbreaks have adversely affected imports from those countries.[468] The company is not involved, however, in the longline fishery for tuna and swordfish.

Sulpesca Exportaçao: This Santos firm handles a variety of seafood products, including swordfish. FDA has approved an exemption to the automatic detention alert for swordfish (appendix F2a).

Taiyo: Taiyo has a processing plant in Santos where it produces frozen fish packed in plastic bags. It also markets imported products (mostly from Chile and Uruguay). Some of this product is in the form of consumer packs. Taiyo is the Brazilian distributor for Fripur (Uruguay) and other Latin American producers of frozen fish products. The company also markets the catch of its affiliated company, Imaipesca. The swordfish is exported to the United States. FDA approved an exemption to the automatic detention alert for swordfish on February 11, 1997 (appendix F2a). Much of the tuna, billfish, and shark are marketed domestically. There is a large population of Japanese-Brazilians living in the Sao Paulo area and these affluent consumers provide a ready market for bigeye and yellowfin tuna and other species suitable for *sushi*. Some of its major customers are institutional buyers. Taiyo also markets the fresh longline catch. The

Photo 141.--The Brazilian-Japanese joint venture company, Taiyo, is one of Brazil's most important fishing companies. The firm plays an important role in the longline fishery. Dennis Weidner

swordfish is mostly exported, but the rest of the catch is sold domestically. The company's largely Japanese staff is particularly expert in meeting the demands of the Japanese-Brazilian community in the São Paulo area. Most of the longline catch is sold fresh, but some is also sold frozen in the domestic market.[469]

Torquato Pontes: This Rio Grande (RGS) based company was founded in the late 1940s. It leased a small Japanese longliner, the *Mari 1,* in April 1988. The vessel operated out of Rio Grande until January 1989 (appendix A2c3).[470]

B. Labor unions

Most of the fishermen working aboard commercial fishing vessels belong to SINPESCATRAESP, which is a part of the Fedração Naval de Trabalhadora en Transportes Marítimes Fluviais e Pescadores. Fishermen were once a minor part of the union, but in recent years have become an increasingly important component of the union. Membership is not obligatory, but almost all the fishermen aboard commercial longliners join the union. There are 3,000 members in Santos and 2,300 members in Rio Grande. The workers on the longliners generally report earnings substantially above average Brazilian wages. The contracts differ somewhat from port to port. There are also differences between the contracts on Brazilian and foreign-leased vessels. Much of the income comes from a share of the catch (appendices A2e2-3).[471] The crew also retains the shark fins, which the vessel owner does not share in, although there have been negotiations over this. The owners reportedly wanted a share of the fins. Some union officials thought that the fishermen should be less concerned over the fins than about their overall compensation. Most of the fishermen, however, insisted on reserving the fins entirely for themselves.[472] The fishermen also often receive a few fish, usually slightly damaged so they can not be exported, which they can sell locally to supplement their earnings.

Photo 142.--Most fish was purchased in unsanitary, open-air markets in the 1950s. High quality fresh fish was usually only available near the ports and at markets in a few large coastal cities.

Photo 143.--A wide variety of fish are available in Brazilian markets, but quality standards are often poor. These fish at a retail market are left in the open without ice. Dennis Weidner

Photo 144.--The shark catch is marketed domestically. Brazilian artisanal fishermen established a local market for shark which the commercial longline fishermen subsequently developed. D. Weidner

Photo 145.--Longline-caught fish being stacked after purchase. They will be loaded on waiting refrigerated trucks for sale in nearby São Paulo. Dennis Weidner

Photo 146.--After the auction at the Santos Terminal de Pesqueiro, purchase tags are attached to each fish. This identifies the buyer at the end of the auction. Dennis Weidner

Photo 147.--Fish are filleted for customers at this open-air Brazilian market located along side the Natal fishing port. Dennis Weidner

XII. Markets

A. Domestic

Brazil is South America's largest country with a land area comparable to most of the United States (excluding Alaska) and a large and rapidly growing population. The market for seafood is excellent. Brazil's large population creates a much larger demand for seafood than can be supplied by domestic production. Economic expansion in recent years has created a large and growing middle class, expanding the market for good quality seafood. Products which were once considered primarily for the rich are now finding acceptance with the country's expanding middle class. This is easily the largest potential market in Latin America.[473] Brazilians have traditionally preferred red meat to seafood, but there are distinct regional and other demographic differences.

Regions: Fish is most popular in northeastern Brazil where one company representative explains "they really know how to eat fish."[474] Consumers in southern Brazil tend to be less interested in seafood, although income levels tend to be higher on average in the south. One of the best markets for seafood in Brazil is the large urban complex of São Paulo, and much of the Santos catch, including the longline catch, is sold there--with exception of swordfish which is exported.

Ethnic groups: Some of the different ethnic groups comprising modern Brazil show distinct consumption patterns. Brazil was settled by the Portuguese in a colonization process which resulted in the loss of most of the native population.[475] Slaves were imported from Africa to run the sugar plantations. Subsequently there has been an influx from Germany, Italy, Poland, Spain, and elsewhere in Europe. Many popular Brazilian seafood dishes are heavily influenced by their Portuguese traditions. One small ethnic group, Japanese-Brazilians, particularly enjoy seafood. This community is concentrated in the São Paulo area and is the principal market for much of the tuna and billfish landed in the longline fishery.[476]

Urban areas: Much of the consumption of seafood is concentrated in urban areas, especially the coastal cities. Sao Paulo is one of the world's largest cities. Population estimates vary, but the city probably has about 15 million inhabitants--greater than the population of many countries. The massive size of São Paulo makes it the country's largest seafood market. The substantial Japanese-Brazilian population makes it the major domestic market for fresh tuna and billfish. Rio de Janeiro has a population of over 5 million.[477] Several other coastal cities have sizeable populations. The coastal location simplifies handling and the population is more accustomed to seafood than inland consumers. The necessary infrastructure of cold stores and refrigerated storage also makes possible supplying a high quality product.

Unlike many other Latin American countries, the Brazilian fishing industry does not fully supply the domestic market. Brazil's large and growing population creates a massive demand for inexpensive seafood, but the growing middle class is demanding better quality product, greater variety, and convenience packs. Traditional suppliers have been Scandinavian companies shipping cured fish, including such favorites as dried cod (*bacalhau*). In recent years Brazil has been importing larger quantities of frozen groundfish from Uruguayan and Argentine companies. Increasing quantities of Chilean fish, especially farm-raised salmon, has appeared on the market in recent years. Brazil does not, however, normally import tuna, swordfish, and billfish.

Photo 148.--Brazilian ports generally have attached fish markets. One of the biggest is at Santos near São Paulo. Dennis Weidner

Traditionally fish consumption was dependent upon imported cured products to prepare traditional Portuguese foods or fresh fish. Until the 1950s, the lack of a modern distribution system restricted seafood sales in many inland communities to cured or canned product. The development of a modern transportation network and cold storage system has opened up many new domestic markets, although the country's distribution system is still inadequate and this limits seafood marketing.[478] While consumers readily accepted fresh fish, many have hesitated to purchase frozen fish--in part because of the undependable quality standards. Consumers in recent years, however, have become increasingly willing to accept frozen fish as greater quantities of high quality product have become available. This trend, especially since the late 1980s, has accelerated, particularly among middle class Brazilians who have home refrigerators and find that the convenience and ease of preparation makes frozen fish particularly appealing.[479] The new generation of Brazilian consumers is much more interested in seafood and it is now common for middle-class Brazilian families to eat seafood once or twice a week.[480]

Much of the fish consumed in Brazil has been fresh fish purchased in seafood markets near ports or landing sites, central markets, and *feiras*. In recent years supermarkets have been opened and many of the newer ones handle seafood.

Photo 149.--Most Brazilian municipal markets have fresh fish stalls, like this one in Rio Grande do Sul. Dennis Weidner

Photo 150.--Market conditions are improving in Brazil. This ambitious retailer installed a modern, sanitary display case in his market stall, the first to do so in Natal. D. Weidner

Seafood markets: Artisanal fishermen generally sell their catch at landing sites. Some of the catch is sold to dealers and some is sold for local consumption. Marketing facilities vary. Some communities have built stalls to display and fillet the fish. In major ports, important seafood markets offering a wide variety of seafood are located close to the fishing port. The stalls in many of these markets are often under water and the fish may not be iced. Most are open air stalls with no protection from

Photo 151.--Supermarkets are winning increasing market share, especially with the middle class, but municipal markets still play an important role. Dennis Weidner

flies and other insects. Some seafood markets are more developed, with the fish kept in protected display cases. Even in the more rudimentary markets, one usually find at least some proprietors who keep their fish on ice and have improved the stall with tiles and attached glass or plastic display cases. Locally landed product dominates, but some product is trucked in from other areas of Brazil and some imported product (mostly from Chile, Argentina, and Uruguay) is also available. Almost all of the product is fresh, but a few dealers in recent years have added small freezer cabinets with some valued-added frozen products.

Central markets: Away from the major ports, fish is often sold in the central markets where most consumers have traditionally bought perishable food such as meat, poultry, fruit, and vegetables. These markets are generally located in city centers and many have fish stalls.

Free markets (*feiras livres*): In many Brazilian cities, especially in southern Brazil, perishable foods are commonly sold at roving or free *feiras*. Once a week a street at selected locations is closed and merchants set up stalls to sell produce. Often one or two trucks with fresh fish is present at these *feiras*. Rio reportedly has 188 of these *feiras*. Sao Paulo may have over 700. Shark and tuna will usually be offered, usually in *postas* or steaks.[481]

Peddlers (*ambulantes*): Most large cities have peddlers marketing fish. They usually market inexpensive fish (like sardines) in the poorer sections of the city. Rio in 1998 had about 2,000 peddlers selling about 200 kg daily.[482] The number in Sao Paulo probably exceeds 8,000. Peddlers are unlikely to handle expensive species like tuna or swordfish, but may occasionally offer shark.

Super markets: Super markets in recent years have come to play an increasingly important role in food retailing. These markets are generally located in suburban areas and usually cater to middle class consumers. As many small stores style themselves *supermercados*, many Brazilian supermarkets have adopted the term *hypermarkets*. Brazilian supermarket are some of the largest in South America and some compare in size, presentation, and security to North American supermarkets. One *hypermarket* in Natal, for example, gives a card with a computer code of the customer's car license plate which must be presented when leaving the market. Some of the major national chains include: Carrefour, Pão de Açucar, Peralta, (El) Porado, San José, Sé, and Quaçu. Some important regional chains in Rio and spreading into other areas are: Bom Preçio, Casas Sendes, Paes Mendonça, Tres Poderes, and Freeway. Almost all of the major stores offer frozen fish and many of the newer ones have fresh fish counters.[483] Supermarkets now account for a substantial portion of Brazilian seafood sales. In Rio over half of the seafood is sold at central markets. The proportion may be less in smaller inland cities, but supermarkets now play a key role in the national market. Most supermarkets sell much more frozen than fresh product. Chain seafood sales vary from about 40 to 400 t monthly.[484] Most of the value-added frozen product is sold in supermarkets.[485] Tunas and swordfish may be found in fresh fish counters, but are more likely found in central markets and from fish mongers.

Fish mongers/shops (*peixarias*): Brazil has fish mongers in major urban centers. Various assessments of the Rio area found 120-150 fish mongers offering fresh fish.[486] A few shops specialize in high quality fresh fish. One store in Santos offers high quality frozen product produced in an adjoining processing plant that competes well with the nearby fresh fish market.[487]

Institutional food service: Several Brazilian companies report that some of their major customers are institutions (hospitals, factory cafeterias, etc.).

Photo 152.--Frozen swordfish trunks at a Santos shop. The trunks are used to make various value-added retail packs such as chunks for shish-ka-bobs and steaks for grilling. Dennis Weidner

Such institutions require frozen fish.[488]

The authors believe that the Brazilian swordfish catch is mostly exported. Swordfish is unknown to many Brazilian consumers. It has only been available in a few port markets. It is not as highly prized by affluent Japanese-Americans as the tunas taken in the longline fishery. The whitish color of the fish makes the species less desirable to Japanese-Brazilian consumers.[489] Thus the fishing companies reportedly export almost all of their catch.

Some swordfish is available domestically, especially at the seafood markets adjoining the major ports where the longline catch is landed (Rio Grande, Santos, and Recife). Much of the product available locally is fish which may have been somewhat damaged and therefore not export grade. Brazilian consumers who try swordfish appear to like it, but the product available locally is one of the most expensive species. It is generally sold as "meca", the Japanese word for swordfish because of the major role the Japanese have played in developing the fishery. It is displayed in large trunk sections from which customers can order specific amounts. Some merchants also display swordfish cut into large chunks (for shish-ka-bobs) or small fillet-like cuts. The chunks and small fillets are also available frozen in some supermarkets and fish stores.

Other swordfish products were introduced in 1998 as prices have fallen so much that the domestic market had become increasingly attractive. Low international prices in 1998 caused several companies to rethink their marketing strategies. Several companies expand efforts to promote the species in the domestic market. Norte Pesca, for example, conducted a series of promotions in supermarkets to allow consumers to test swordfish.[490]

Photo 153.--Faud Hissa Hazin, Norte Pesca Director is a pioneer of Brazil's modern fishing industry. Here he holds the new frozen swordfish steaks his company is marketing domestically. D. Weidner

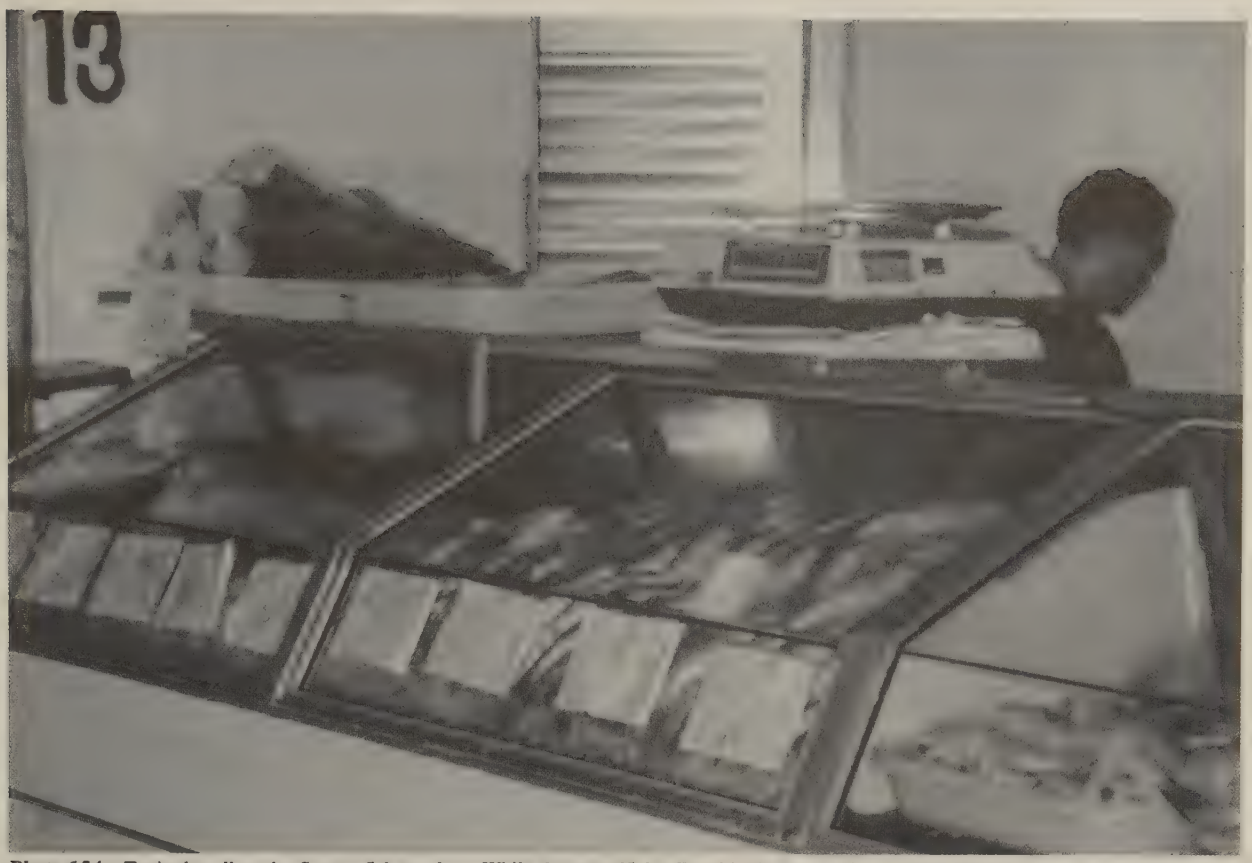


Photo 154.--Typical stall at the Santos fish market. While the swordfish offered is the largest item, it is mostly the small swordfish that are marketed in Brazil. Dennis Weidner

Photo 155.--Customers at a Brazilian fish market examining the product. Many customers get to know their fish monger and rely on his expertise. Dennis Weidner

Photo 156.--Tuna, shark, and other species for the domestic market are loaded into insulated or refrigerated trucks at Santos and transported to markets in São Paulo and other cities. D. Weidner

Photo 157.--Refrigerated trucks being loaded at the Santos Fishing Terminal. Unlike many Latin American countries, much of the Brazilian longline catch is sold domestically. D. Weidner

Photo 158.--The "Carrefour" supermarket (hypermarket) chain is a growing source for fresh and frozen fish sales to Brazil's expanding middle class. Carrefour is a French company. D. Weidner

Photo 159.--Brazilian companies in 1998 began directing more swordfish to the domestic market, such as these swordfish "postas," because of falling international prices. Dennis Weidner

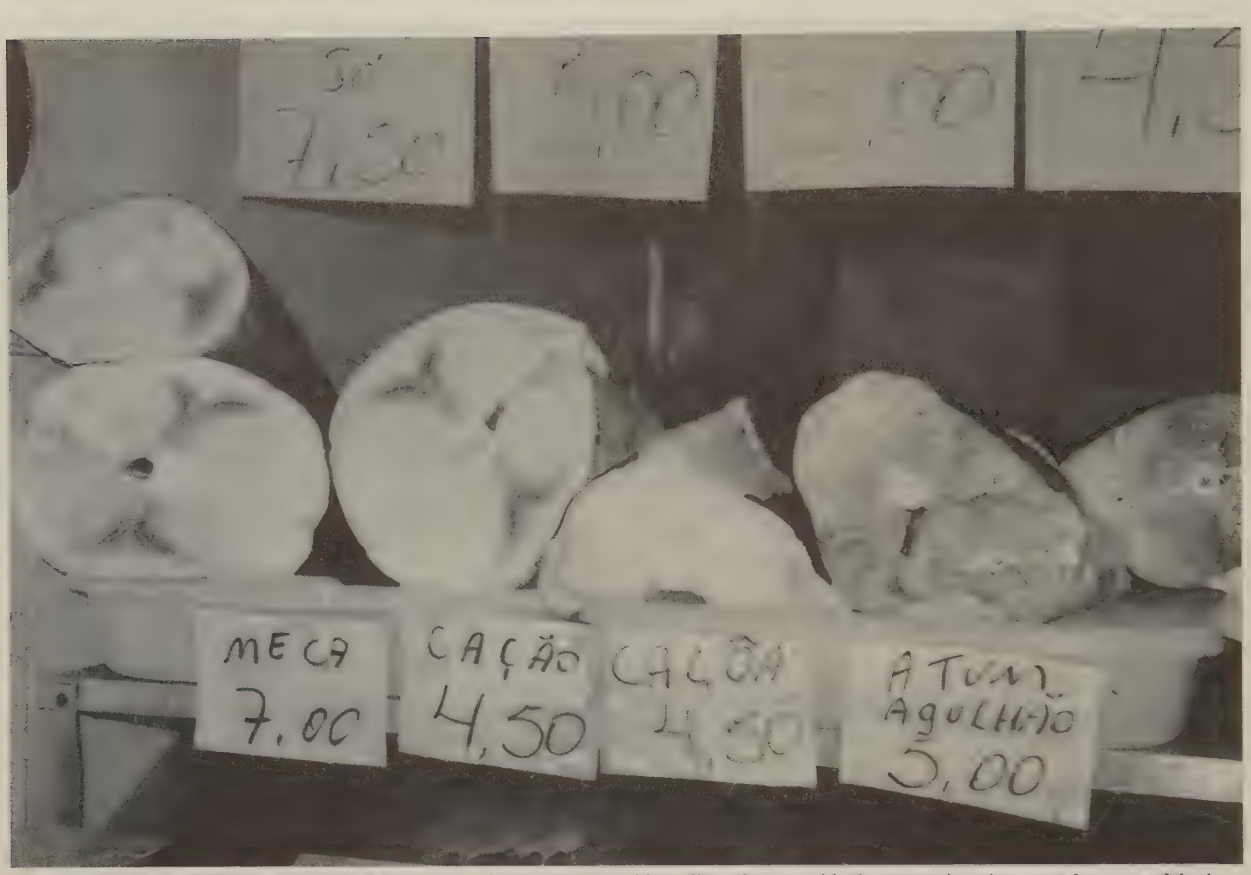


Photo 160.--This swordfish (meca), shark (cação), and tuna (atum) at this stall are kept outside the protective glass case because of the large size and difficulty in handling. Dennis Weidner

Photo 161.--Brazilians use the Japanese term "meca" when selling swordfish in the local market, an indication of the importance of Japanese fishermen in developing the longline fishery. D. Weidner

Photo 162 - Trade agreements between Latin American countries have resulted in expanding regional trade. Chilean fishery products are now widely available in Uruguay and Brazil. Dennis Weidner

Photo 163 - Several Brazilian companies are now producing frozen products from the longline catch. Like this frozen shark produced by Norte Pesca. Dennis Weidner

Photo 164.--Interior view of the CPC frozen fish retail store in 1996. A new owner now operates it as New Symbol, but still specializes in high-quality frozen fish. D. Weidner

Brazilian companies were hopeful that expanding the domestic market would help to reduce dependency on the international market. Most companies had channelled as much product as possible to export markets. Swordfish was popular in these markets, especially the United States, and could be easily sold at high prices. International prices by mid-1998, however, declined to a point that several companies decided they could do better on the domestic market. Swordfish is unknown to most Brazilian consumers and this required some marketing. This was not an impossible task; shark was not nearly as popular in Brazil before the 1960s, but in only a few years was successfully introduced. Shark is now well received by the Brazilian consumers and is now almost always available in seafood markets. Brazilian companies conducted supermarket promotions for swordfish and expanded processing of frozen products for the domestic market.[491]

The market situation of an overvalued real, high domestic prices, and weak international prices changed dramatically in January 1999. The 1999 decline in the real on foreign exchange markets will make domestic sales much less profitable and will affect company marketing decisions. This will certainly affect plans to expand domestic sales.

The actual quantities of swordfish marketed in Brazil is unknown. Brazil does not have an effective fisheries statistical system and basic data on the domestic market is unavailable from IBAMA. The authors believe that a rough approximation of the proportion of the catch marketed domestically is about 10-20 percent, based on conversations with Santos and Natal industry representatives and IBAMA officials. Probably about 10 percent of the catch does not meet export standards. Additional small quantities are sold in the domestic markets; hence, 10-20 percent of the catch sold domestically appears to be a reasonable estimate.[492] This is, however, only a rough estimate and the authors

Photo 165.--Tunas are an important part of the bycatch of the Japanese-style longline fishery. These tunas will mostly be marketed in São Paul to Japanese-Brazilian consumers. Dennis Weidner

have no statistical data to substantiate it.

Photo 166.--Swordfish (meca) and tuna (atum) are two of the most expensive fish offered by this Santos monger, but flounder (lenguado) sells for slightly more. Dennis Weidner

A basic comparison of the domestic catch data with the import data of major importers indicates that in a few years (1991 and 1993) about 8-10 percent of the swordfish catch may have been marketed domestically. Available import data for the other years, however, covers only a fraction of the catch (appendix G1b1). The fact that foreign imports exceed the Brazilian catch calls into question existing catch data. This suggests problems with either the catch or trade data. The statistical problem does not appear to relate to differing marketing channels of the domestic and leased catch, although this could have been reflected in the low level of foreign imports during 1994-95 (appendix G1b2). Brazilian industry representatives with which the authors spoke insist that most of the catch is exported primarily to the United States. They are highly skeptical about foreign import data that does not account for the quantity of swordfish being landed in Brazil.[493]

Most of the other species taken in the longline fishery are sold domestically.

Tunas: Several species, especially the tunas, have substantial export value. Unlike most other Latin American countries, there is a very strong market in Brazil for high quality fresh tuna. Brazil has the largest Japanese community in Latin America. Japanese-Brazilians, unlike many other ethnic communities, appear to be reluctant to assimilate into the general population. They are maintaining close family ties as well as many Japanese social and diet patterns. As a result, with the exception of swordfish, much of the tuna and billfish catch of the longline fishery is sold at near export-level prices to Japanese Brazilians. The Japanese-Brazilian population appears to be capable of consuming virtually all of the longline tuna and billfish catch. Some of the companies involved indicated in fact that there is often a shortage of tuna. Much of the Japanese-Brazilian community is centered in the São Paulo area and are willing to pay high prices for tunas such as albacore, bigeye, and yellowfin suitable for *sushi*.[494] Elsewhere in Latin America longline fishermen generally export high-quality tunas. The Japanese-Brazilian consumers appear to be primarily concerned about the color of the fish, preferring red meat. One observer insisted that the color was much more important than many other factors, such as fat content.[495] Other industry sources, however, insist fat content is the key factor.[496]

Billfish: Much of the billfish catch of the longliners is also marketed domestically. Japanese-Brazilians are also the major consumers of billfish, but these species are not as desirable as tunas and sell for lower prices (appendix F1). The Japanese are not as accustomed to billfish. The flesh is harder to cut and dryer than tuna and the color is not red like tuna. The texture of the flesh is a substantial impediment as the Japanese generally use this species for *sushi* and other raw preparations. Flesh that is difficult to cut and chew is thus much less desirable than the more suitable tunas. Both marlin and sailfish are sold, but the marlin is generally preferred. Demand for billfish does increase

Photo 167.--These shark trunks at Norte Pesca are being prepared for shipment to interior markets. Dennis Weidner

seasonally as the fish are more desirable for *sushi* when they acquire more fat. Some Brazilian-Japanese consumers, for example, will only purchase sailfish in the spring (September-November).[497]

Sharks: Almost all of the Brazilian shark catch is sold domestically. Artisanal fishermen in the 1960s began fishing for small sharks like narrownose smoothound (species like *Mustelus schmitti*) using bottom longlines and gillnets. There are no statistics on artisanal landings, but they continue to be important target species for the artisanal fishermen. Commercial trawler fishermen began targeting sharks in the 1970s. Fishing effort on these species is increasing. The commercial trawler fishermen have increased catches of smoothound (*M. schmitti)* and soupfin shark (*Galeorhinus galeus)* from 1,400 t in 1973 to 3,500 t in the 1990s. Catches of another abundant species like angel sharks (*Squatina occula*) ranged from 1,200-1,500 t during this same period. Prices were comparable with most other demersal species (Sciaenids). The market these fishermen developed in the 1960s-70s proved tailor made for the longline fishermen. While their major target was tuna, the fact that a market existed for the large accompanying bycatch of shark enhanced the profitability of the fishery. Some of the longliners, especially off the northeastern coast even targeted shark.[498] The Brazilian consumers is today very accustomed to eating the species. As a result, shark prices have increased. Shark is now commonly available in seafood markets and other retail outlets. Both artisanal and commercial fishermen supply shark. Much of the commercial longline catch is blue shark. The carcasses (headed, gutted, and finned when landed) are sold by the fishing companies to wholesalers in both fresh and frozen form. Much of the longline catch in 1998 was being landed in Itajaí and trucked to wholesalers for distribution. Thus wholesalers in Santa Catarina and São Paulo states were handling much of the catch. The wholesalers process the carcasses into frozen fillets and slices.[499] Sharks sell at relatively high prices, only a little less than swordfish and tuna. Shark has become an important component of the profits at most fishing companies deploying longliners over those companies with a strong focus on swordfish. Some companies will even target shark on some sets, calculating that the a larger catch of shark will more than compensate for the lower price.[500] Often one sees shark along with swordfish sold cut into cubes for grilling as shish-ka-bobs. Brazilian artisanal fishermen have been actively marketing sharks since the 1960s and commercial fishermen since the 1970s.[501] Brazil has the largest

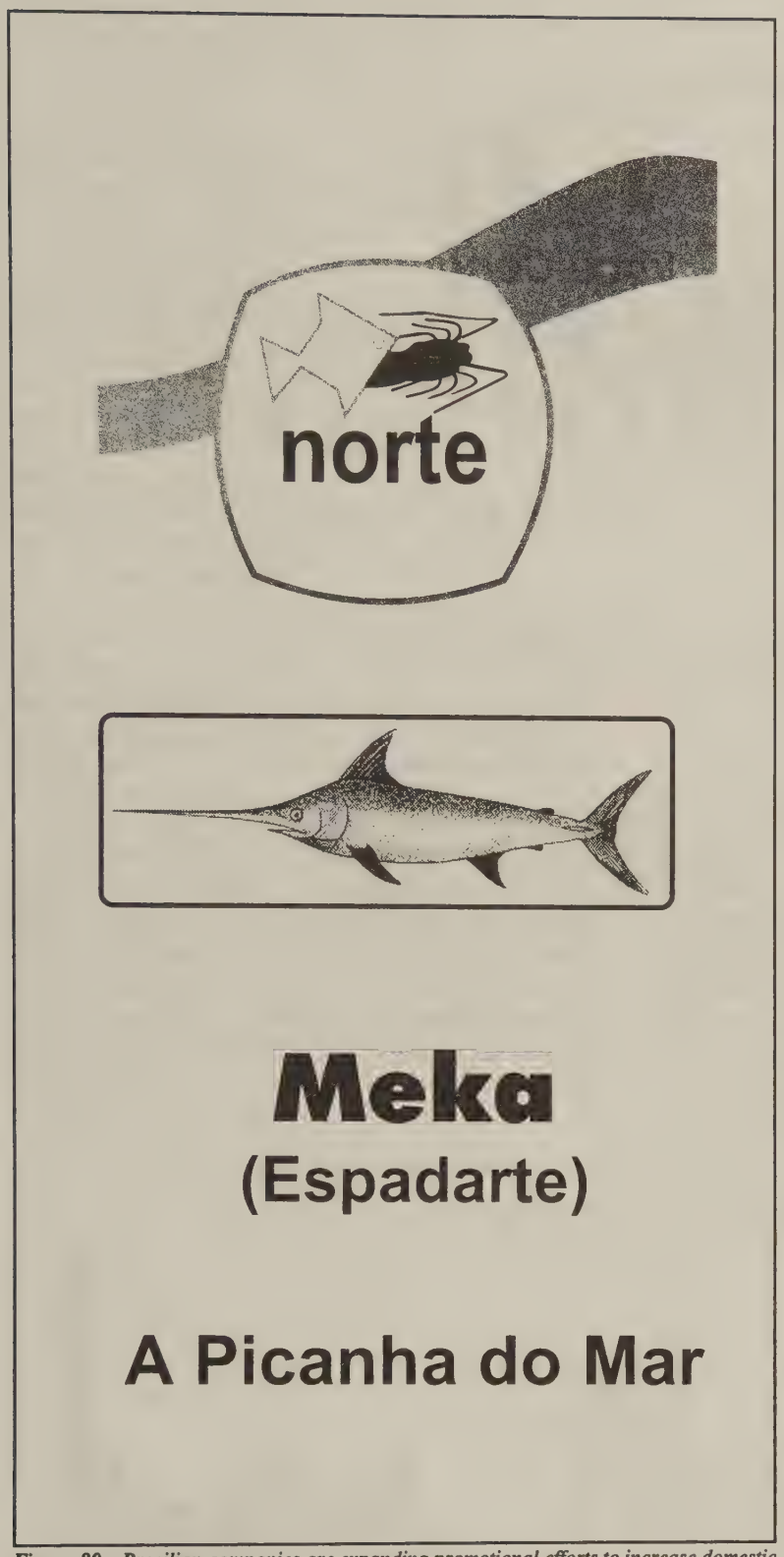


Figure 80.--Brazilian companies are expanding promotional efforts to increase domestic demand. This promotional brochure was prepared by one company for distribution in supermarkets.

and strongest market for sharks in Latin America.

Other: A variety of other fish taken by the longliners is marketed domestically. Some of the most common are snake mackerel or escolar (*Ruvettus pretiosus*), oil fish which is a kind of snake mackerel (*Lepidocybium flavobrunneum*) and opahs (*Lampris guttatus*), There may be small export shipments, but for the most part the catch of these species is sold domestically.[502] The Brazilians do not appear to distinguish between the different species of snake mackerels (such as oilfish) in the local market. The fish are called "peixe prego" or "peixe rato" (rat fish), not a very appealing market name. Oil fish is usually a small part of the catch, but some sets produce substantial catches. Most oilfish is sold fresh, but some is cured. Some Brazilian report it makes an excellent smoked product. Smaller quantities of opahs are taken and they are mostly sold as fresh fillets. It once was marketed as a salmon substitute (because of the distinctive bright orange color of the opah fillets), but with the appearance of Chilean salmon at attractive prices in the Brazilian market, this practice has declined. Opahs are not taken in large quantity, but a few are commonly taken by the fishermen each trip.

Fishery products in Brazil have generally been produced and marketed by small or medium sized companies. Reports from Brazil in 1998 indicate that two large Brazilian companies are now marketing a line of seafood products. Both Sadia and Perdigao are launching seafood products. While their initial lines do not include swordfish, the entry of these large concerns could have a significant impact on the Brazilian market and the small concerns that currently dominate it. One Brazilian journal believes that Sadia's and Perdigao's participation in the market could help stimulate domestic seafood consumption.[503]

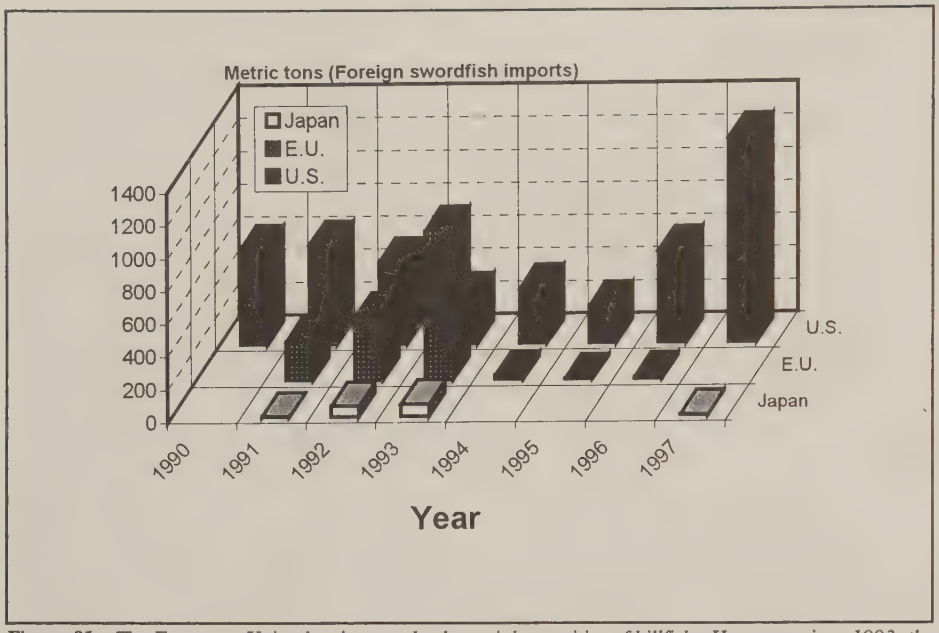


Figure 81.--The European Union has imported substantial quantities of billfish. However, since 1993, the United States has been the major market for swordfish.

B. Trade

1. Exports

Brazil is the principal Latin American producer of Atlantic swordfish. While current Brazilian export data is not available, the authors believe that almost all of the export-grade product taken by the commercial fishermen is exported. There are, however, no Brazilian expert data available on swordfish exports. The authors base their assessment that most of the catch is exported entirely on industry representatives who insist they export most of their catch. An analysis of catch and foreign import data, however, reveals some significant apparent statistical anomalies (appendices G1b1-2). If industry assessments are correct, available data, probably the trade data, is flawed or incomplete.[504] The authors have, however, been able to satisfactorily resolve the statistical anomalies.

Any definitive assessment of Brazilian swordfish export trends is difficult in the absence of Brazilian export data. Foreign import data can offer some insights. This is especially true as Japan, the European Union (especially Italy and Spain), and the United States import over 90 percent or more of total world exports.[505]

Analyzing available foreign swordfish import data is complicated by several factors. Brazilian sources are convinced that U.S. import data does not reflect the actual quantity being shipped.[506] Japanese data does not separate swordfish from other billfish. Little import data is available from Taiwan. Different national statistical systems may be treating the foreign-leased catch differently as they are foreign vessels. Available foreign import data thus must be viewed with considerable reservations. The data shows substantial fluctuations in swordfish imports during the 1990s, from a low of only 230 t (1995) to a high of 1,270 t (1993). Shipments in 1997 were about 1,250 t (appendix G1a). European Union (EU) shipments were important until 1993, but the U.S. has been the primary market. While the accuracy of the quantity imported has been questioned by Brazilian sources, the U.S. import data does show a major increase in shipments since 1995. Shipments more than doubled in both 1996 and 1997. Preliminary data suggests that there will be another increase in 1998, but more modest as catch levels began to decline in August

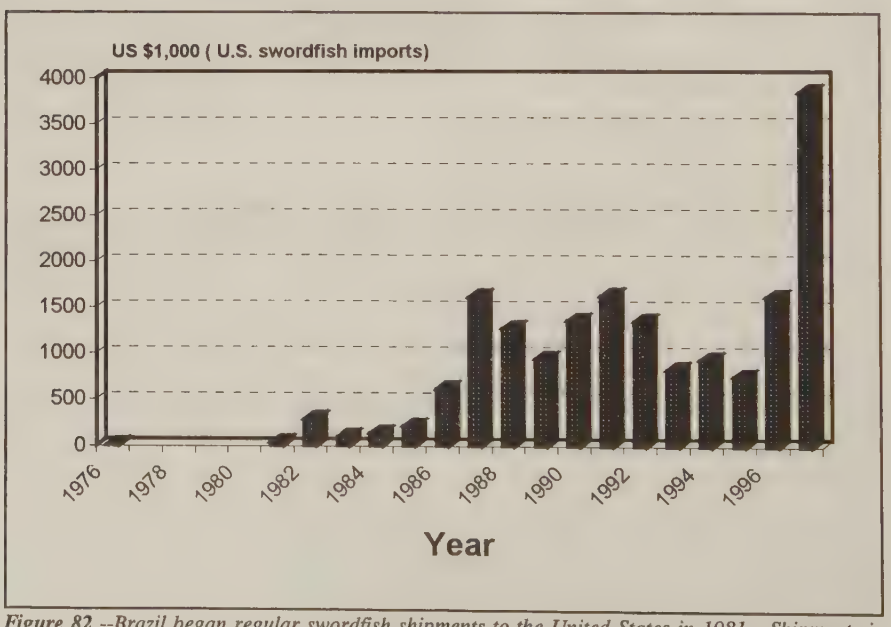


Figure 82.--Brazil began regular swordfish shipments to the United States in 1981. Shipments in 1997 reached a record $318 million.

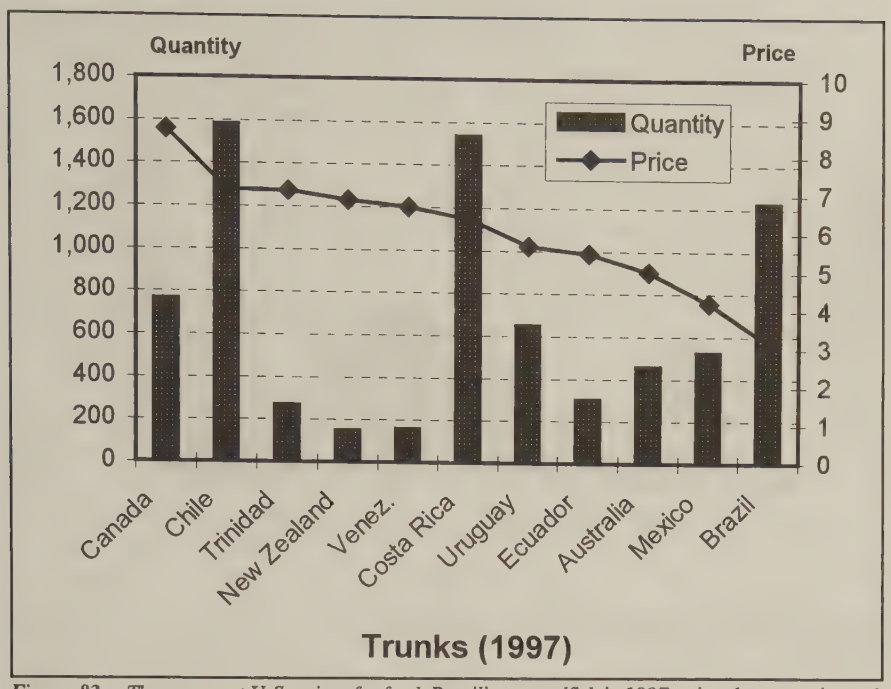


Figure 83.-- The apparent U.S. prices for fresh Brazilian swordfish in 1997 as in other years is much lower than for comparable product from almost any other country.

1998 (appendix G2a1).

The principal market for swordfish is normally the United States, although shipments to the European Union have in some years exceeded those to the United States. Shipments to the Japanese are of minor importance, despite the important role that the Japanese play in the country's longline fishery. Taiwan trade data suggests that Brazilian shipments are minimal or none.

Available information on Brazilian swordfish shipments in major world markets is as follows:

United States: The principal export market for Brazilian swordfish is the United States. Brazil began regular swordfish shipments to the United States in the early 1980s. Shipments first exceeded 100 t in 1986 and peaked at over 600 t in 1991 (appendix G2a1). Shipments subsequently declined sharply to only about 285 t in 1993. The reason for these declines are not fully understood, but probably are because of a diversion of product to the European market. There were sizeable shipments to the EU (primarily Spain) in 1991-93 and lesser quantities in 1994 (appendix G4). Even after shipments to the EU declined in 1994-95, there were no immediate increases of exports to the United States. Shipments to the United States totaled only 228 t in 1995, the lowest levels since 1986 when Brazilian swordfish catches were much lower (appendix E3b1a-c). Since 1995, however, there have been major increases in swordfish shipments to the United States. Shipments doubled to 560 t in 1996 and doubled again to 1,200 t in 1997. The reason for the sudden increase in shipments to the United States are not fully understood, but assumed to be primarily due to increased catches and the reported virtual cessation of shipments to alternative markets. Brazilian swordfish shipments are reaching significant levels. The value of the 1997 shipments to the United States was over $3.8 million (appendix G2a2). The product form of Brazilian shipments to the United States is primarily unprocessed trunks. The authors know of no value-added product currently being exported. Brazil has exported both fresh and frozen product to the United States. As recently as 1994, about 25 percent of shipments were frozen. Shipments since 1995 have been almost entirely fresh product (appendices G2a1-2). Most of

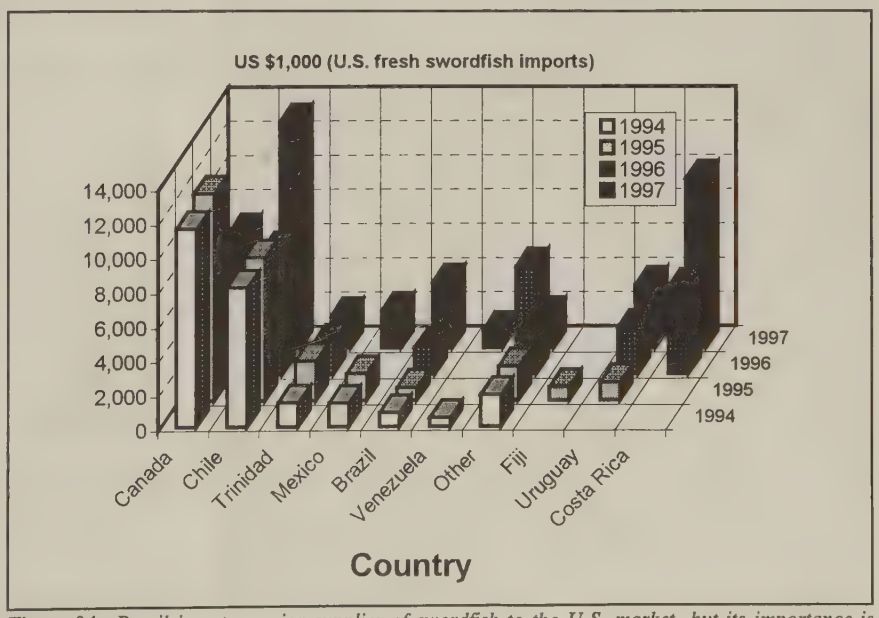


Figure 84.--Brazil is not a major supplier of swordfish to the U.S. market, but its importance is increasing.

the shipments are air-freighted to New York and to a lesser extent Miami (appendices G2b1-2). The average apparent prices of the fresh product entering the two airports in some years have been comparable (1994) and in other years substantially different (1995). Much higher-priced product, for example, entered Miami in 1995, $4.12, compared to only $3.15 for New York (appendices G2b1). Nominal apparent prices for fresh Brazilian swordfish since 1988 have been relatively constant at $2.23-$3.31 per kg (appendix G2c). The apparent prices have increased from $2.74 in 1988 to $3.09 per kg in 1997, which in inflation-adjusted terms means that prices have actually declined somewhat. Brazilian exporters have reported substantial price decline in 1998.[507] The impact of the Asian financial crisis is probably one factor. Environmental boycotts have also had some impact.[508] The sharp decline in the value of the real in January 1999, however, will make these low prices much more attractive than to Brazilian compoanies than was the situation in 1998. Brazil is not a major supplier to the U.S. market, which in recent years has primarily been supplied by Chile and Canada and since 1996, Costa Rica (appendices J2d1-2). Brazilian shipments normally constitute one to eight percent of all U.S. swordfish imports (appendix G2d1-2). Brazilian swordfish in the United States appears to sell at much lower prices than that of other major suppliers. The authors do not have access to data based on actual sales. A rough idea of price trends, however, can be computed by calculating the value/quantity data reported by U.S. Customs.[509] This data has to be used with caution because some suppliers (Canada and Chile) ship value-added product. Brazilian product, however, sells well below product from other Latin American countries that also ship trunks. Brazilian swordfish in 1996 sold for $2.84 per kg, less than half of the product shipped from Trinidad and Mexico and only one-third of the price for Costa Rican product (appendix G2e1). Similar price differences were noted in 1997 although the disparities were not as extreme (appendix G2e2). There is normally a distinct seasonal pattern in Brazilian swordfish shipments to the United States with most of the product entering in the second half of the year, primarily August through November (appendix G2g). The pattern, however,

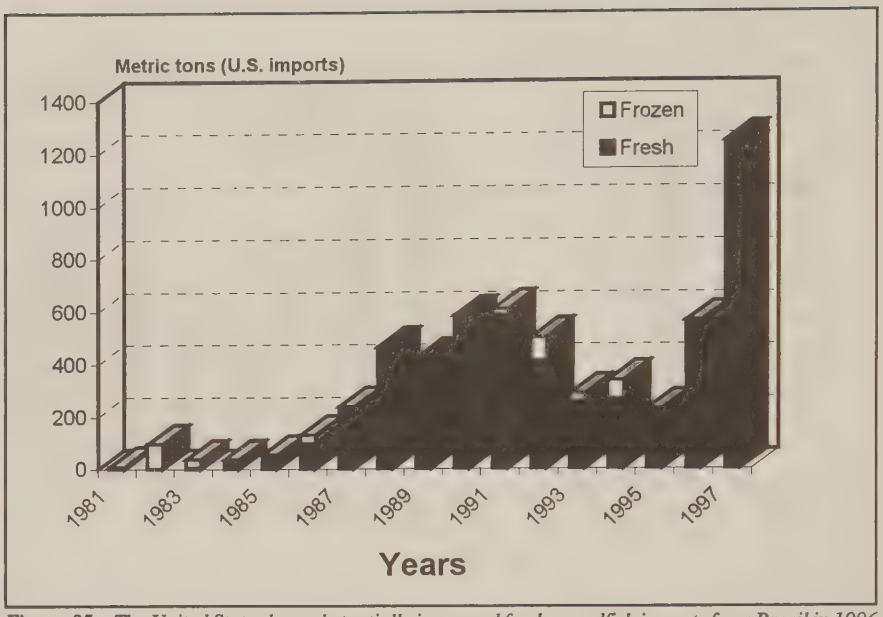


Figure 85.--The United States has substantially increased fresh swordfish imports from Brazil in 1996 and 1997.

Photo 168.--Brazilian swordfish is mostly imported into the United States as fresh trunks and then processed in U.S. plants. Dennis Weidner

can vary. Very large quantities of swordfish, for example, were shipped to the United States in the first half of 1998 (appendix G2g).

European Union: Brazil exported sizeable shipments of mostly frozen swordfish to the European Union (EU) during the early 1990s. Shipments increased from 240 t in 1991 to a peak of 930 t in 1993 (appendix G1a). The 1993 shipments to the European Union substantially exceeded shipments to the United States, the usual market. Shipments in 1994, however, declined sharply to less than about 30 tons. The principal importing country was Spain, but there were also some substantial shipments to Italy. Minor shipments have been reported to France, Germany, the Netherlands, and other EU countries (appendix G4). Almost all of the shipments to the EU are frozen, but minor quantities of fresh product have been shipped to Spain and Portugal. Since 1993, only minor quantities of swordfish have been shipped to the EU, 6-27 t annually. The reason for this sudden decline in shipments is unknown. Spanish fishermen are active in the south Atlantic, but primarily the eastern equatorial areas of the South Atlantic. A few Spanish and Portuguese longliners, including some Spanish-owned flag-of-convenience vessels, have worked with Brazilian companies. There may have been some activity before, but such arrangements were formalized in 1996 (appendix A1b7). Official trade data may have been affected by the Spanish vessels working off Brazil. The EU appears to be treating the catch of the leased Spanish vessels as Spanish catches rather than imports from Brazil.

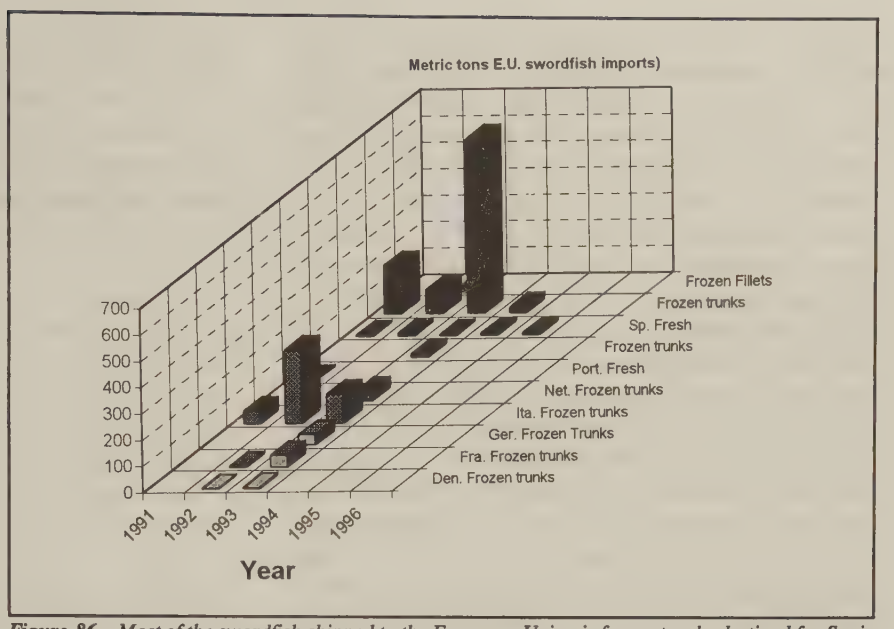


Figure 86.--Most of the swordfish shipped to the European Union is frozen trunks destined for Spain and Italy.

Japan: Precise data on Brazilian swordfish exports to Japan are unavailable. The authors know of no Brazilian data and Japanese trade data has no separate customs category that specifically identifies swordfish. Instead, swordfish are listed under a basket category for billfish. The authors have no information on the species composition of this category, but believe about one-third may be billfish.[510] Brazil has only exported small quantities of swordfish to Japan. Shipments in the late 1980s, for example, ranged from zero to three tons. Shipments in the 1990s increased somewhat, but peaked at only an estimated 75 t in 1993 (appendix G3a). (This estimate of 75 t of swordfish is based on the Japanese report of 220 t of billfish shipments for all species in 1993.) No shipments were reported in 1994-96 and only minimal quantities in 1997. The lack of significant shipments to Japan is surprising. There are significant seafood marketing contacts between Brazil and Japan. Japanese immigrants have played a important role in

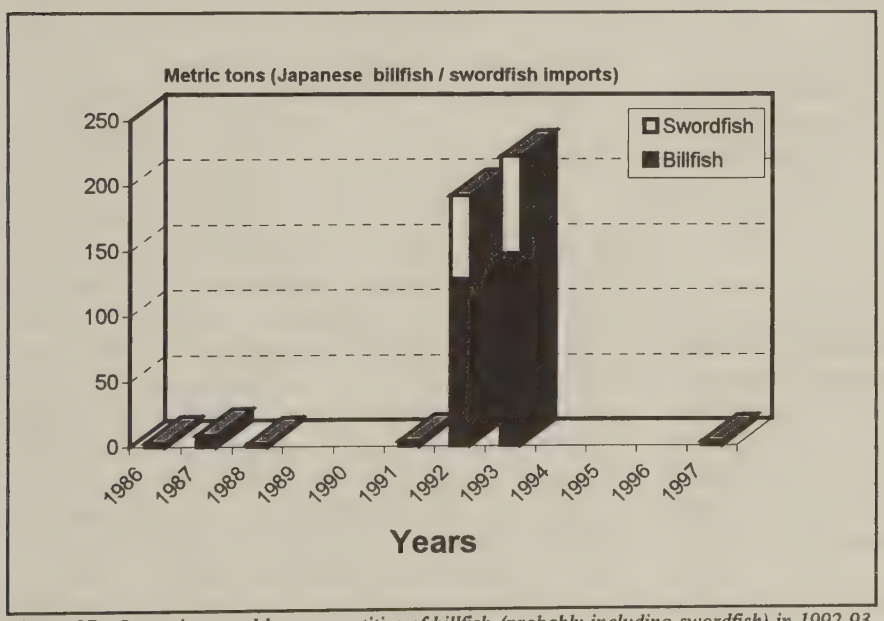


Figure 87.--Japan imported large quantities of billfish (probably including swordfish) in 1992-93, but this was unusual.

the development of the Brazilian fishing industry. Brazilian companies during the 1970s and 1980s contracted Japanese longliners to conduct longline fisheries off southern Brazil. The fact that a significant proportion of the longline is not marketed in Japan is interesting. Other Latin American countries with longline fisheries do ship to Japan.[511] Brazilian fishing companies and other exporters have good marketing contacts in Japan. Brazilian seafood such as shrimp and lobster is marketed in Japan.[512] The domestic marketing of the longline catch, except the swordfish, is due to the substantial population of ethnic Japanese in Brazil who consume much of the tuna and billfish longline catch domestically.[513]

Taiwan: Taiwanese longliners have been active in Brazilian ports since 1991, although operations declined after 1995. The Taiwanese longliners operated under Brazilian flags in association with Brazilian companies. The catch was theoretically landed in Brazilian ports and exported as Brazilian product. Notably other Taiwanese-owned vessels operate on the high seas under Taiwanese or various other flags of convenience. Considering the level of activity, the authors wanted to check Taiwanese import data. Available Taiwanese import data, however, does not include a specific swordfish category. There is an import category translated as "marlin," but the Chinese characters indicate that it is a basket category, including all billfish and swordfish.[514] Relatively small quantities of billfish/swordfish are involved, only 107 t worldwide in 1996 and the country of origin was not specified. This was a new category which first appeared in 1996 and thus no historical data is available. Data for 1997 indicates that most of the fish is imported from Australia and their Brazilian shipments are very small, if any.[515]

Others: Swordfish exports to other countries are believed to be minimal. Export markets for frozen tuna and other oceanic pelagics are somewhat more diverse. Brazilian exporters, for example, have shipped frozen tuna to Argentina for distribution in Buenos Aires restaurants.[516]

2. Imports

The authors have been unable to obtain current Brazilian import data, but believe that the country does not import appreciable quantities of swordfish or most other oceanic pelagics like tuna and billfish. Available trade data indicates that Brazil did import 2.6 t of frozen swordfish from neighboring Uruguay in 1997 (Uruguay, appendix F1b3).[517] The country's longline fishery appears to fully supply domestic demand.

Available fisheries trade data from Uruguay indicates that Brazil does import small quantities of sharks from neighboring Uruguay. Imports totaled over 1,000 t in 1997 valued at $1.2 million (appendix G5). The primary species when specified were Argentine angel, soupfin, smoothhound, and blue as well as rays. It is all low-priced product, although some is processed fillets and skinned product.

XIII. Government Policy

The agency responsible for fisheries in Brazil through 1998 has been the Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis (IBAMA) which replaced the former fisheries agency Superintendência do Desenvolvimento da Pesca (SUDEPE) in the early 1990s. IBAMA is Brazil's environmental agency. Industry groups have criticized what they perceive as IBAMA's bias toward environmental issues. Many industry representatives believe that an environmental agency should not be responsible for regulating an economic activity like fisheries. As a result, responsibility for fisheries will now be shared with a new Departamento de Pesca e Aquicultura in the Agriculture Ministry. The new director, appointed in 1998, is Gabriel Calzavala. IBAMA will, however, continue to issue fishing permits, establish seasonal closures, set limits on vessels and catches, and other activities which are considered environmental matters.[518] The reorganization in early 1999 is still in progress. Industry sources are hopeful that a new fishery agency with a production focus will be helpful. IBAMA retains, however, many management responsibilities that are in most other conducted by the fisheries agency itself. It is still unclear how the new administrative organization will work and what the relationship between DAP and IBAMA will be.

A. Fisheries law

The basic Brazilian fisheries law is Decreto-Lei N°221 of February 28, 1967. The law was expanded by Decreto-Lei N°1.098 in 1970. Many decrees and amendments have followed since.[519] The authors, however, have no recent references to Brazilian fisheries law.

B. Regulations

Brazil during the 1980s and early 1990s had no minimum size restrictions for swordfish (appendix E6). Brazilian officials indicated in 1991 that such regulations are unnecessary because fishermen only catch adult fish. Officials at the time indicated that they closely monitor catches and would implement minimum size regulations if necessary.[520] Officials indicated in 1993 that because of substantial increases in the longline fishery that they had decided to implement the ICCAT minimum size recommendations and were in the process of doing so.[521] The regulations establishing a minimum size of 25 kg were reportedly issued in 1996. The current regulation is Portaria 115 issued August 17, 1998. IBAMA and now the new Departamento de Pesca are also responsible for licensing vessels.[522]

C. Limits

Brazil modified its 1970 declaration of a 200-mile Territorial Sea in 1993 to conform to the more widely accepted 12-mile limit.[523] The same law established a 200-mile Exclusive Economic Zone (EEZ). Brazil signed the Law of the Sea Convention in 1982 with reservations and ratified it in 1988, again with reservations. The reservations pertain to foreign military exercises or maneuvers.

D. Management

Brazilian officials have expressed great concern over the management of swordfish in the south Atlantic. The decline of north Atlantic swordfish has caused distant-water fishing countries, especially the Spanish, to redirect effort into the south Atlantic. As a result of the expanded effort, ICCAT had set "caps" for swordfish catches based primarily on historical catches (appendix E3a8). The effort to limit fishing in the south Atlantic has been criticized by Brazilian and Uruguayan officials. They feel that the development of their coastal fisheries should not be limited because distant-water countries have expanded operations and in some case are not adhering to ICCAT catch guidelines.[524] Neither Brazil nor Uruguay participated aggressively in the ICCAT proceedings when the historical base period was decided upon. The period chosen was the period after the Spanish entered the south Atlantic swordfish fishery in 1988, thus providing for continued significant Spanish fishing and relatively low Brazilian and Uruguayan caps (appendix E3a8). Brazilian officials have devised several alternative allocation schemes taking into account historical fishing, coastal state preferences, economic development levels, and other factors.[525] Brazilian officials plan to continue pursuing changes in the ICCAT guidelines.

Brazil has signed the Law of the Sea Treaty and the Agreement for the Implementation of the Provisions of the U.N. Convention on the Law of the Sea relating to the conservation and management of straddling and highly migratory fish stocks as well as the Code of Conduct for Responsible Fisheries. One tenant of Brazilian management policy is the principle of preferential treatment for developing fisheries, especially in operations in their own EEZ and adjacent areas. A statement by the Brazilian delegation at the 1997 informal intercessional ICCAT meeting indicated that:

> The Brazilian delegation wishes to point out the differences in harvesting capacity between developing coastal states and developed countries. The former are still in an early stage of development of marine technology. They lack specific expertise in pelagic fishery and are forced to limit their fishing activities within the EEZ. In contrast, developed countries have far more advanced technological means, with fleets operating in distant waters, and frequently count on subsidies that reduce their operational costs. As a result, with less effort they are able to reach fish stocks in distant regions. These differences must be taken into account in the discussion of a mechanism to define a percentage quota of sea catches.[526]

Brazilian officials are especially critical of the use of historical catch trends in setting national quotas. Brazilian officials stated that "... the adoption of international mechanisms should consider both the specific situations of developing countries and the larger harvesting capacities of developed countries."[527] Brazilian officials insist:

> Brazil's extensive coast and EEZ undoubtedly represent one of the most valuable assets for its economic development as well as its strategic sources of food, which is of crucial importance to minimize the lack of protein in its population nourishment. For this reason, Brazil will hardly agree to renounce a significant participation in the south Atlantic swordfish fishery.[528]

Brazil adheres to the ICCAT minimum-size regime.[529] Brazilian officials are very critical, however, of the failure of other countries to adopt and enforce the ICCAT guidelines. Brazilian policy statements indicate:

> ... one of the main interests of coastal south Atlantic States is reflected in their responsible attitudes towards the conservation and management measures. The same is not true in respect to other countries, who increased fishing in 1995 in spite of 1994 ICCAT recommendations that limits the catches in the years 1995 and 1996 to the average catch of the 1993-94 period. Fortunately, due to some other countries who complied with the 1994 ICCAT recommendations or even unilaterally reduced fishing, the total increase of swordfish catches in 1995 were not higher than expected.[530]

E. Licenses

Brazil has pursued highly restrictive policies regarding foreign fishermen. The Brazilian policy has been basically to prohibit foreign-flag fishing in Brazilian waters.[531] Various countries (including Italy, Japan, Korea, Poland, Spain, the USSR, and the United States) have contacted Brazilian authorities regarding fisheries access, but the Brazilians have repeatedly shown little interest and have discouraged such proposals.[532] Brazilian officials have instead encouraged distant-water companies to consider joint ventures. The terms offered, however, have been of interest to few foreign fishermen.[533]

Photo 169.--Foreign longliners, like this Portuguese vessel, have played a major role in the Brazilian tuna and swordfish fisheries--primarily through leasing arrangements. Dennis Weidner

F. Joint ventures/Leasing arrangements

Brazilian officials have encouraged the development of the domestic fisheries for tuna and tuna-like species through promoting joint ventures and licensing arrangements. Brazilian regulations proved to be highly restrictive and few foreign companies determined that joint ventures would be profitable. Potential investors especially objected to the requirement that the Brazilian partner hold the majority interest.

Arrangements for leasing foreign vessels have proved much more attractive. A few vessels were leased before 1976. SUDEPE approved regulations authorizing vessel leasing contracts in 1976. As a result the number of vessels leased increased significantly. The new regulations permitted established Brazilian companies to lease foreign vessels that were well-equipped and manned by a trained crew. The Brazilian company had to have a least 5 years experience as well as the necessary financial and administrative capability. The charter fees were required to be less than the "liquid" value of the catch.[534] Brazilian regulations conferred the same legal benefits to the foreign vessels chartered by Brazilian companies that was conferred on domestic vessels. The catch of high-value species can be exported while the bycatch sold on the domestic market.[535] Brazilian companies concerned with the catch limits established on swordfish by ICCAT have asked the government to restrict leasing arrangements so that Brazil's ICCAT allocation can be reserved primarily for the domestic fleet. As a result, the new Departamento de Pesca decided in August 1998, to freeze additional licenses for longliners to current levels for 3 years.[536]

One of the interesting aspects of the leasing program is the dominance of the program by the Japanese and the decision of Spanish fishermen not to lease their vessels until 1996.

1) Japan

Japan's almost exclusive domination of the leasing program probably reflects the substantial number of Japanese distant-water vessels and the cultural affinity with Japanese-Brazilians involved in the fishing industry. Japan is the Asian country which initiated distant-water longlining. Gear, fishing methods, and vessel types were basically developed by Japanese fishing companies. They also deploy the largest fleet of distant-water longliners for which they have an active program aimed at obtaining access to national EEZs.[537] Japanese longliners were active off Brazil as early as the 1950s and in fact conducted the first longline trials. It is thus understandable that the Japanese would be active participants in the leasing program. Combined with this has been a substantial Japanese immigration to Brazil before and after World War II (1939-45). Many of these immigrants entered the fishing industry. Many Japanese immigrants came to Brazil after World War II when the depressed war-torn economy offered few prospects. The Japanese immigrants were some of the few participants in Brazil's fishing industry with technical academic training in fisheries. Brazil at the time had no fishery training schools. The industry was almost entirely artisanal and many Brazilians looked down on fisheries as a low status occupation. Japanese immigrants played a major role in establishing some of Brazil's first commercial fisheries and in introducing modern technology. One consequence of the involvement of Japanese-Brazilians in the fishing industry was that the Japanese companies desiring to gain access to Brazilian waters had local Brazilians of Japanese ancestry which they could work with. This is an important factor which should not be underestimated because the Japanese in general do not move as easily in Latin American cultures as do Europeans or even Americans.

The declining role of the Japanese and exit from the leasing program is probably due to a general retrenchment of Japanese distant-water fisheries. Japanese fishing companies are having increasing problems recruiting fishermen for distant-water operations. These fishermen have to be away from home for extended sea trips and work under often harsh conditions. Falling catch rates and earnings mean that the incentives for such difficult work are not as strong as they used to be.[538]

2) Spain

Spanish tuna purse seine fishermen and tuna/swordfish longline fishermen deploy their vessels on far-flung distant grounds. While Asian fishermen have deployed a substantial number of longliners off Brazil, Spain has not, despite the number of longliners deployed in the south Atlantic fishery.

Purse seiners: Spanish tuna purse fishermen, for instance, deploy tuna purse seiners in the Pacific and Indian Oceans under licensing or other arrangements with countries there rather than in tuna fisheries off Brazil. One Spanish fishery association executive reports purse seine operations in Pacific international waters and transshippments through Ecuador.[539] Other Spanish fishermen have obtained fishing rights within Ecuadorean

waters. Spanish purse seine fishermen have been unable to obtain similar arrangements with Brazilian officials.

Longliners: Despite the large number of Spanish longliners involved in the south Atlantic swordfish fishery, the Spanish had not until 1996 pursued joint-venture arrangements with Brazil. Some Spanish fishermen have deployed longliners in the Pacific.[540] These Pacific operations involve substantial additional costs over Atlantic fisheries. Most would have preferred south Atlantic operations closer to their home port. Spanish longline fishermen have succeeded in developing port access arrangements with neighboring Uruguay to the south.[541] There were some exceptions. Some of the flag-of-convenience vessels participating in leasing arrangements are believed to have been owned by Spanish interests.

The decision of the Spanish, with these exceptions, not to pursue arrangements in Brazil were due to a variety of factors. One, Spanish fishermen did not find the conditions offered by the Brazilians to merit the costs involved--although Asian fishermen did. Two, the Japanese established arrangements with Brazilian officials and businesses, some with Japanese affiliation, before Spanish longliners were active in the south Atlantic. These arrangements and other established relationships may have made it difficult for other countries to find local partners and start up new operations. Three, the Spanish fishermen had access to the port of Montevideo to transship their catch, making arrangements with the Brazilians less critical. Despite those difficulties, Spanish fishermen begun in 1996 to lease their vessels to Brazilian companies. These leasing arrangements are believed to have been with Cabedelo de Pesca and involved operations off northeastern Brazil. Six Spanish longliners are known to have been active out of Cabedelo in 1998.[542]

G. Promotion

SUDEPE initiated a program in 1976 to help build a modern fishery for tuna and related species.[543] Research was expanded to help identify grounds and seasonal concentrations. Assistance was provided to help obtain modern processing equipment, promote exports, and train fishermen. SUDEPE determined that a modern tuna fishery would require advanced technology and significant capital investments, neither of which were readily available. SUDEPE officials attempted to promote joint ventures.[544] Foreign companies were uninterested in such ventures under the restricted terms offered by Brazil. SUDEPE, as a result, decided to encourage Brazilian companies to lease foreign vessels.

Photo 170.--Brazilian fisheries scientist, Dr. Alberto Amorim from the Instituto de Pesca, interviewing a longliner crew member in Santos. Dennis Weidner

Photo 171.--Brazilian fisheries scientist working with CEPSUL/IBAMA, J.N. Antero da Silva, discussing fishing operations with a Rio Grande do Sul fisherman. Dennis Weidner

larval surveys, fisheries oceanography, maturity and fecundity, and stomach content analyses.[546] Brazilian research specifically addressing the longline fishery for swordfish has been more limited. There has been some work done on tunas, and other highly migratory species, including swordfish, by IBAMA (the Brazilian fisheries agency), and university groups.

Brazilian scientists are very concerned about the impact of the 1998 financial crisis on government funding. There have been massive financial outflows from Brazil in 1998, forcing the Government to float the real, Brazil's currency. The result was a massive decline in the real's value, the consequences in early 199 are not yet fully known. The devaluation of the real may have major financial consequences both in Brazil as well as the wider world economy. The International Monetary Fund (IMF) has provided a major rescue package, but it was not sufficient to support the real. The Brazilian Government is

XIV. Research

The first significant Brazilian fisheries research initiative occurred in the late 1950s when the Ministry of Agriculture entered into a 10-year cooperative research program with the FAO. When the program ended, SUDEPE continued fishery research programs. SUDEPE gave considerable attention to tuna, considered an under-utilized species at the time which could be targeted by local fishermen. SUDEPE issued a study paper in 1979 assessing tuna stocks to encourage expanded efforts. Much of the Brazilian work has focused on skipjack which was targeted initially by Brazilian pole-and-line vessels and subsequently small seiners.[545]

Brazilian research on oceanic pelagics has largely focused on tunas. Work has involved experimental fishing,

Photo 172.--CEPSUL researchers have concentrated primarily on coastal species, but they have also compiled a valuable data base from the foreign leased longliners. Dennis Weidner

implementing a stringent austerity program which includes cuts in government-funded research.[547] The decline of the real in early 1999 may force even more drastic cuts. Fishery scientists like other national researchers will certainly have to make major adjustments. It is not yet clear, however, to what extent on-going programs will be affected.

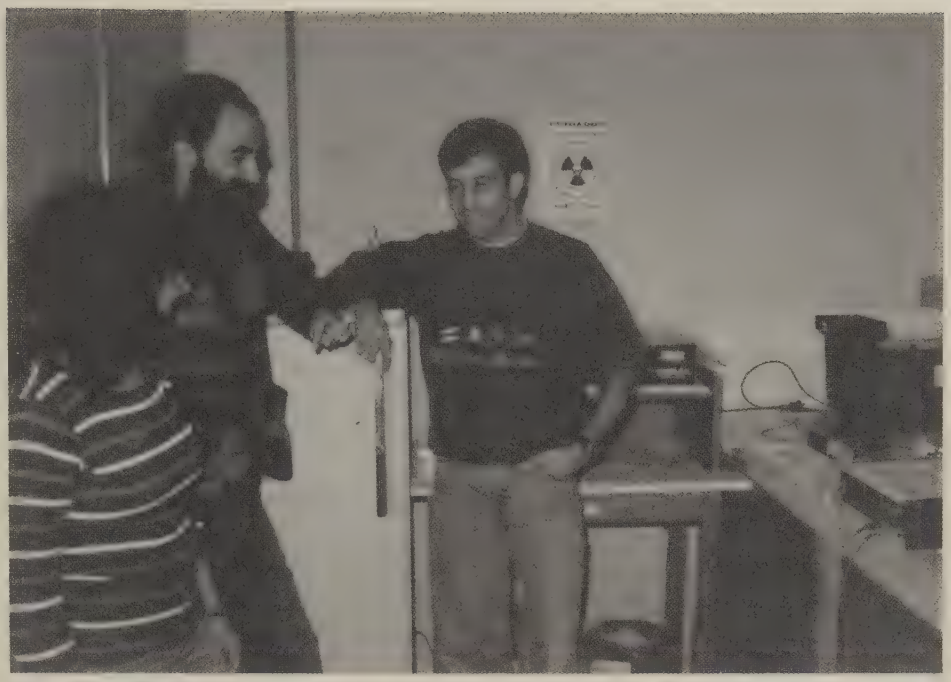


Photo 173.--FURG researchers are conducing genetic work on a variety of coastal and oceanic pelagic species. Dennis Weidner

The major Brazilian research institutes known by the authors to be currently working on oceanic pelagics or whose work is of interest to fishery scientists involved with oceanic pelagics includes:

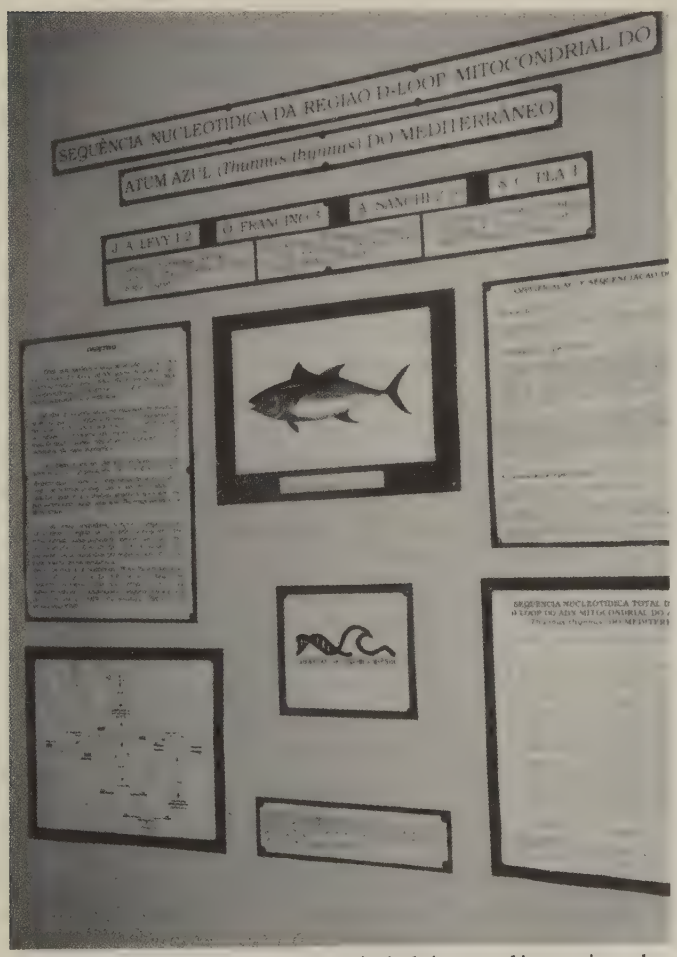


Photo 174.--FURG researchers are particularly interested in genetic work on coastal and offshore species. Dennis Weidner

Brazilian Space Agency: The Brazilian Space Agency has drafted a joint project with Argentina to put up small and medium satellites. The proposed satellites will, among other purposes, be used for fisheries research.[548] U.S. and foreign swordfish fishermen have demonstrated the effectiveness of remote sensing in locating potentially productive grounds.[549]

CEPSUL: The Centro de Pesquisas y Extensao Pesqueira das Regioes Sudeste-Sul (CEPSUL) is an IBAMA research institute. The Center has primarily focused on species of interest to local artisanal fishermen operating in coastal waters. Large numbers of foreign longliners, however, have operated from the port of Rio Grande where one of CEPSUL's laboratories are located. CEPSUL researchers at Rio Grande have compiled an important data base on the foreign operations, as well as published several valuable papers on the longliner operations.[550] There is also a CEPSUL laboratory at Itajaí in Santa Catarina. Some of the domestic Brazilian longline fleet operates from Itajaí, but the authors have few details on research addressing the longline fishery at the CEPSUL Itajaí lab. One researcher is working on the sharks (mostly blue shark) taken in the artisanal gillnet and pelagic longline fishery off southern Brazil. He is at the same time collecting data on both the commercial species (swordfish, tuna, and billfish) as well as the non-commercial bycatch (turtles). Turtles boated alive are being tagged.[551]

CEPENE: See IBAMA.

CPPM: The CPPM is the former Divisão de Pesca Maritima at the Instituto de Pesca. See the IP for details.

DAP: The new Departamento de Pesca e Aquicultura (DAP) which was created in 1998 will share responsibilities for managing fisheries with IBAMA. The relationship between the two agencies is not fully understood. IBAMA will continue to have important management responsibilities and may coordinate research activities as well. The author's are unsure about DAP's role in the Brazilian fisheries research program.

FURG: Researchers at the Department of Oceanography of the Fundação Universidade do Rio Grande do Sul (FURG) concentrate primarily on the important local demersal fisheries.[552] One FURG researcher has focused on coastal, demersal sharks.[553] There has also been some limited work on oceanic pelagics targeted by the longline fishery off of southern Brazil.[554] Rio Grande is one of the principal ports for the Brazilian longline fleet and researchers at FURG have thus shown some interest in tunas and other oceanic pelagics (swordfish, billfish, and sharks). FURG researchers in 1996 planned a 2-year longline study to test gear and fishing methods on swordfish, tuna, and other oceanic pelagics using the FURG research vessel.[555] One FURG researcher has reportedly submitted a project to help provide satellite data to Brazilian fishermen.[556] Researchers at the FURG Laboratorio de Bioquímica Marinha (LBM) are also doing some DNA sequencing on bluefin tuna as well as several coastal fish and crustacean species.[557] FURG is expanding its genetic work and has been cooperating with the Universidad de Barcelona (UB) in Spain.[558] Activities in 1999 involve work on transgenic fish. FURG researchers obtained the cDNA of the Brazilian silverside (*Odonthestes argentinensis*). They have completed work on the introns and exons and plan to work with the UB on gene sequencing. Work is also under way on crustaceans and other species including tuna. The LBM is working on skipjack (*Katsuwonus pelamis*) to do Restriction Fragment Length Polymorphism (RFLP) analysis obtained from PCR amplified D-loop, mtDBA.[559] Other FURG researchers are working on the distribution and abundance of seabirds and assessing interactions with the longline fishery. They also in 1998 were testing "Birdline," a mitigation device developed in Australia.[560]

Photo 175.--As swordfish are headed and gutted at sea, researchers are unable to collect precise size and sex data or take samples of vital organs. Dennis Weidner

IBAMA/SUDEPE: IBAMA and the previous Brazilian fisheries agency, SUDEPE, have been responsible for collecting fishery statistics. Catch data published by both ICCAT and FAO is supplied by IBAMA. Researchers at IBAMA/SUDEPE have assessed the data supplied by the domestic fleet as well as foreign vessels leased by Brazilian companies.[561] The Brazilian highly migratory statistical program has focused primarily on tunas, which constitute most of the catch. The statistical program, however, has also collected some data on swordfish. Brazil has, for example, compiled length/frequency data on swordfish since 1971 and in 1986 SUDEPE indicated they were also compiling size/frequency data on billfish.[562] Budget limitations have severely limited data collection, especially of the baitboat and artisanal fleets. ICCAT is working with IBAMA to improve the data collection system.[563] Currently, effective IBAMA data collection programs only exist in Rio Grande and Santa Catarina. (Sao Paulo also has an effective data collection system, but it is conducted by the IP under an arrangement with IBAMA.)[564] ICCAT has worked with IBAMA personnel, providing training to at-sea observers.[565] IBAMA has funded some limited at-sea sampling of longliners.[566] Regional IBAMA units that are active in research on highly migratory species include Centro de Pesquisas y Extensao Pesqueira

Photo 176.--Instituto de Pesca researchers (Dr. Alberto Amorim, Lúcio Fagundes, and Dr. Carlos Arfelli) collecting samples at the Santos fishing port. D. Weidner

das Regioes Sudeste-Sul (CEPSUL) and Centro de Pesquisas y Extensao Pesqueira do Nordeste (CEPENE). IBAMA plans further cooperation with ICCAT's Enhanced research Program for Billfish in 1999. Plans currently call for putting some observers aboard commercial longliners in 1999. ICCAT is providing some funds to support this effort.[567] One of IBAMA's major initiatives has been the Recursos Vivos de Zona Economica Exclusiva (REVIZEE) aimed at assessing the marine living resources in the county's 200-mile EEZ.[568] The Brazilian Government created a new fisheries agency (DAP) in 1998, but IBAMA will continue to play an important role in fisheries and marine activities in general, including the research program. REVIZEE may be affected by the 1999 financial crisis, but most Brazilian researchers believe that the program will be continued because of its importance to Brazilian research institutes and ministries.[569]

IO: The Oceanographic Institute (IO) of the University of São Paulo has worked on tunas and other oceanic pelagics, but no details are available.

IP: The Instituto de Pesca (IP) in Santos is a unit of the São Paulo state Secretariat of Agriculture.[570] It has an agreement with IBAMA to collect fisheries statistics in São Paulo state. The IP conducts research on the species of greatest interest to the fishermen in the state of São Paulo through its Centro de Pesquisa Pesqueira Marinha (CPPM).[571] The CPPM primarily focuses on demersal fish (snappers/groupers), sardines, coastal sharks, shrimp, and langostino. The IP also does gear work, especially on pair trawling and bycatch problems.[572] The IP's CPPM also has an active program on tunas, swordfish, billfish, and oceanic sharks led by Dr. Alberto Amorim and Dr. Carlos Alberto Arfelli. Dr. Arfelli, now the CPPM Deputy Director, specializes in swordfish. The IP works with ICCAT, exchanging data and organizing training programs.[573] The IP has provided size frequency data on swordfish, tunas, and billfish to SUDEPE/IBAMA and ICCAT since 1991.[574] The IP has collected extensive data on artisanal, commercial, and recreational billfish fisheries, but budget restrictions have made it difficult to update the data. The IP was planning to do so with ICCAT assistance in 1992.[575] The IP currently samples oceanic pelagics and encourages commercial fishermen to tag juveniles when they are landed live. They conduct occasional at-sea sampling of both domestic and foreign-leased vessels. They also have conducted one of the few Latin American tagging programs for oceanic pelagics in cooperation with NMFS researchers. About 50 tunas, swordfish, billfish, and sharks have been tagged from 1982-85. The program was resumed in 1995 and about 90 fish have been tagged.[576] While not focused on swordfish, the program has provided some of the few actual information of swordfish movement in the south Atlantic. An 1.5-year old, 14-kg swordfish tagged off Santa Catarina in 1982 was retaken by Uruguayan fishermen in 1993.[577] Two other tags have been recovered. One was a 23-kg swordfish tagged close to the coast of Uruguay and retaken about 100 km from Florianópolis.[578] Details on the second are not currently available. The IP is also participating in the CULTIMARES FAD project.

MML: Researchers at the Marine Mammal Lab of the Museu Oceanografico "Prof. Eliezer C. Rios" in Rio Grande have done some work on the interactions between killer whales and longline fisheries.[579]

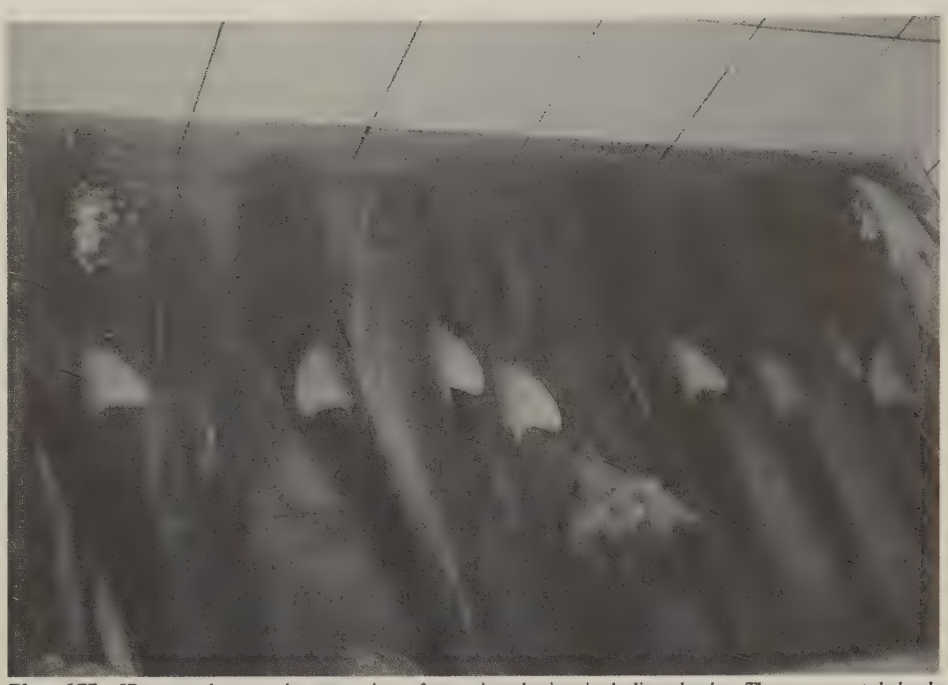


Photo 177.--IP researchers work on a variety of oceanic pelagics, including sharks. These neo-natal sharks were taken from a pregnant female and are being prepared for preservation. D. Weidner

PESAGRO: The State Enterprise for Agricultural Research of Rio de Janeiro (PESAGRO) has done some work on FADs. The worked focused primarily on tuna (mostly skipjack) and the FADs were deployed off the states of Rio de Janeiro, São Paulo, and Paraná during the mid-1980s.[580]

UFCe: The Laboratorio de Ciencia do Mar (UFCe) of the Universidade Federal do Ceará in Fortaleza has reportedly done some work on oceanic pelagics, but no details are available. UFCe is an active participant in the REVIZEE and has recently published an excellent review of Brazil's fishery resources.[581]

UFRJ: The Universidade Federal de Rio de Janeiro (UFRJ) Instituto de Biologia has a Departamento de Biologia Marinha. The authors are not familiar with work at UFRJ on oceanic pelagics. Researchers at UFRJ are currently working on demersal species and publications have included surveys of the demersal longline fishery off the southeastern coast.[582]

UFRPe: The Fisheries Department of the Universidade Federal Rural de Pernambuco (UFRPe) has done some work on oceanic pelagics such as tunas, sharks, and swordfish. UFRPe is the only Brazilian institution in the northeast working on swordfish. It is working on distribution and relative abundance and in 1996 began a research project to assess reproduction, age, growth, and feeding habits. UFRPe hosted a meeting of the ICCAT Standing Committee on research and Statistics (SCRS) at its Recife campus in 1991. One Brazilian source reports that it was noted at the meeting that several Brazilian academic institutions have biological and morphometric data on highly migratory species which they have not yet analyzed and that IBAMA hoped to arrange for the analysis of that data.[583] The results of this work and whether or not data on swordfish was involved is not known. UFRPe also is studying the oceanographic phenomenon supporting oceanic pelagic populations and participates in the 4-year, $20 million Brazilian Exclusive Economic Zone Research Program (REVIZEE). Researchers at UFRPe are coordinating the work of more than 100 scientists involved in the northeastern (Salvador do Teresina) portion of the project.[584] UFPRe researchers worked with a commercial fishing company (Norte Pesca) in 1997 to adapt the gear used by American longliners (appendices D3b and D4b) to the small boat artisanal fishery. Innovations such as monofilament, squid bait, and light sticks greatly increased the income of artisanal fishermen using boats of about 12 meters. Researchers report preliminary results which doubled the income of the fishermen.[585] Norte Pesca finances some of UFPRe's fisheries work, the only Brazilian company making a major financial contribution to a university research program. Norte Pesca also provides access to university researchers on its vessels and at its plants. More than 50 papers have been published as the result of this cooperative effort.[586]

USP: Researchers at the Universidade de São Paulo's Instituto Oceanográfico are active in several areas associated with oceanic pelagics and bycatch issues. Researchers have done some work on marine mammal and other interactions with longline and other fisheries.[587] USP researches have also done some important work on sharks.[588] USP researchers are participating in the CULTIMARES FAD project.

UNESP: The Universidad de Estadual Paulista (UNESP) Julio de Mesgaita Filho has a fisheries program which is working on bycatch problems and various oceanic pelagics (swordfish, billfish, and sharks).[589]

***Photo 178**.--This boat captain is working with the UFRPe to assess small-scale longlining. The buoys will help the researches assess how the line moves in the current. Dennis Weidner*

Photo 179.--UFRPe researcher Dr. Fabio Hazin working with one of his students on a shark project. The UFRPe researchers work on a variety of oceanic pelagics, including swordfish. D. Weidner

Other: Various groups have worked with FADs to aggregate pelagic species. Preliminary reports suggest that the work met with limited success.[590] The initial work begun by FURG and SUDEPE is believed to have focused primarily on skipjack targeted by baitboats and seiners along the southern coast. The research was discontinued in 1985, but resumed by CEPENE to assist artisanal fishermen along the northeastern coast catch tunas and dorado.[591] The Ilhabela Yacht Club has conducted some work on fish aggregating devices (FADs) with billfish in the 1990s and has had some success.[592] The CULTIMARES group plans to put more FADs in during 1999 for both demersal and pelagic species. The CULTIMARES groups includes some industry participants, but generally speaking the Brazilian fishing industry has not been deeply involved in the research effort. The one exception to this has been Norte Pesca, which has strongly supported research at the UFRPe. This has probably helped direct UFRPe's research in a practical direction of use to the country's fishermen. Some Latin American research institutes are prone to focus on highly academic work, often fisheries biology, of little practical utility to actual fishermen. Some of UFRPe's work on artisanal longline fisheries, however, may prove to be of great value to the fishermen and fishing companies working with the fishermen. Brazilian researchers (probably IBAMA) are reportedly working with Argentine and Uruguayan agencies to organize a regional data collection system, including some at-sea sampling.[593] Several foreign universities have done some work in Brazil. The University of Barcelona, for example, has been working with FURG on genetic studies.

Some international organizations have also participated in Brazilian research on longline fisheries for oceanic pelagics. Much of this effort has focused on tunas.

FAO: The Food and Agriculture Organization (FAO) of the United Nations has been active in Brazil since the 1950s when the country first initiated a formal fisheries research program. The first assessment of the potential for developing a tuna fishery was prepared in 1956 as part of the FAO fisheries research program in Brazil. The U.S. master fishermen, E.K.D. Lee, working for FAO, also helped locate commercial concentrations of tunas off the northeastern coast.[594] Brazilian officials reported in 1987 that they were completing the construction of two new research vessels with assistance from FAO. One of the vessels was equipped for tuna research. Plans called for entering into operations in February 1987.[595]

ICCAT: ICCAT's principal activities in Brazil have been to support billfish research through its Enhanced Research Program for Billfish. Activities have included shore-based sampling of selected billfish tournaments, primarily in the Santos area. (Much of the Brazilian recreational fishery takes place in the area around Santos/São Paulo, Rio de Janeiro, and Vitória/Espírito Santo).[596] This work is conducted by the IP. ICCAT in 1998/99 provided some financial support to both IBAMA and the IP to fund an increased number of observer trips on longline vessels.[597]

Photo 180.--The tuna catch contributes a major share to the profitability of longline operations. For many fishermen, tunas are the primary target species. Dennis Weidner

XV. Bycatch

A. Incidental Catch

Both Brazilian and foreign tuna/swordfish longliners report a substantial bycatch or incidental catch of finfish, including billfish, sharks, oilfish and other species--many of commercial value, particularly in local markets (appendices D2h1-2 and E2 series). There are also interactions with several non-commercial species, including turtles, marine mammals, and sea birds. Several of these species, especially the turtles, are endangered species.

Considerable data exists on the bycatch of commercial species (sharks, billfish and others) because these species contribute to the profitability of overall fishing operations. There is little data available, however, on the bycatch and interactions with non-commercial species (turtles, marine mammals, and seabirds). Some Brazilian researchers have recommended that the Brazilian Government initiate observer programs to collect data on longline and other fisheries.[598]

Photo 181.--Tunas are a targeted species and not a bycatch. They comprise an important part of the catch for both the domestic and leased fleet. Dennis Weidner

IBAMA is the Brazilian environmental agency and has implemented many important environmental initiatives. IBAMA instituted a major effort to assess living marine resources in the country's 200-mile zone, Recursos Vivos de Zona Economica Exclusiva (REVIZEE). The effort to assess living marine resources in the Brazilian EEZ was conducted by IBAMA with the participation of Brazilian universities and other institutions. Although no comprehensive, ongoing observer program was instituted to assess longline operations, some limited observer data has been compiled.

REVIZEE has included some observer work, including some trips on longliners, to assess turtle and other bycatch problems.[599] The turtle work was done in cooperation with TAMAR. Some work has also bee done on seabirds. Both IBAMA and the IP have conducted or are planning some observer trips for 1998-99 focusing on billfish. While not a comprehensive program, data from these trips will provide some valuable data. The effort focused on billfish and ICCAT is providing some of the funding.[600] ICCAT has also aided the IP in financing some observer trips to collect billfish data. More observer work is planned. It is unclear how the reorganization of the Brazilian Government will affect these efforts. The new fisheries agency established in the Ministry of Agriculture during 1998 may be less willing to extensively fund observer programs, but the authors have no details on policy initiatives at the new agency. Brazilian fishing companies are optimistic that the new agency will have more of an industry focus than IBAMA. This and the precipitous decline in the real during 1999, which will almost certainly result in government budget cuts, make it unlikely that any major observer programs will be introduced in the near future.[601]

Environmentalists around the world have given considerable attention to fishing gear and the impact on non-target species. As a result many countries have put increasing restrictions on a variety of fishing gear, including purse seine, trawls, and driftnets. The catch

in some fisheries can be many time greater than the target species. Some shrimp trawl fisheries report, for example, a bycatch as much as 10 times the shrimp catch. Longlining is a subject of increasing scrutiny. Environmentalists are especially concerned about longline interactions with seabirds.[602] Other groups are concerned about interactions with sea turtles. While data on such interactions with longlining off Brazil are limited at this time, they do suggest some reason for concern--especially as endangered species are involved. In general, however, longline gear is a much cleaner gear with more limited bycatches than many other fishing gear such as purse seines, driftnets, and trawls. Concerned about the rising criticism of longline gear, foreign and U.S. domestic industry groups have begun to issue press releases and informational packets in an effort to balance the sometime misleading information on longlining sometimes encountered in the mass media. This material often stresses the limited bycatch, efforts to reduce the bycatch such as the use of bird lined, and the economic importance of commercial longlining.[603]

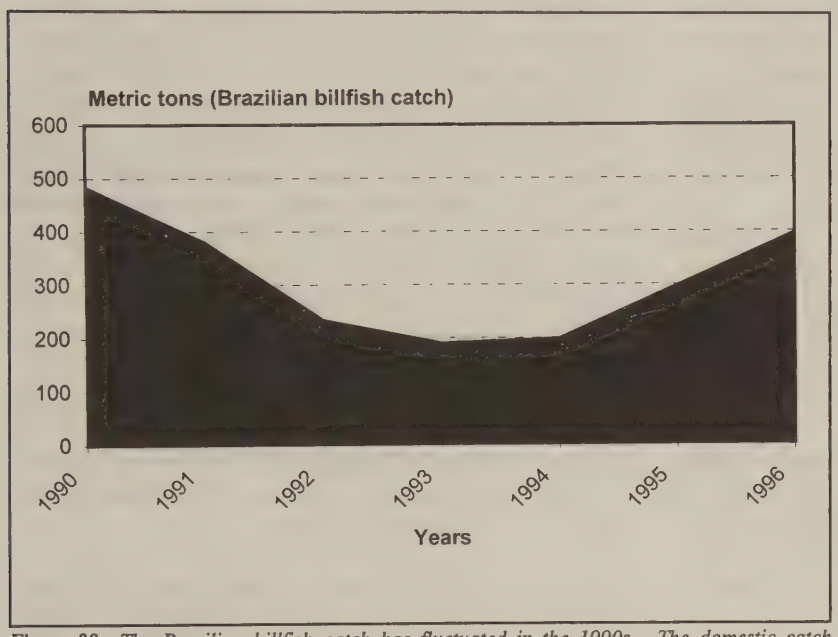


Figure 88.--The Brazilian billfish catch has fluctuated in the 1990s. The domestic catch dropped sharply in 1992 and catches were relatively low in 1993-94.

Some information is available on the principal bycatch species and other species affected by the longline fishery off Brazil. Available information on 1) billfish, 2) sharks, 3) turtles, 4) pinnipeds, 5) small cetaceans, 6) large cetaceans, 7) other species, and 8) seabirds are discussed in the following sections.

1. Billfish

Brazil has a substantial billfish resource. The principal species are sailfish (*Istiophorus platypterus*) and blue and white marlin (*Tetrapturus albidus* and *Makaira negricans*). Substantial numbers of these fish are taken in the Brazilian longline fishery. Brazilian fishermen reported record billfish landings of nearly 485 t in 1990, after which catches dropped precipitously. This appears to be largely due to greatly expanded pressure on the species when large numbers of Taiwan fishermen entered the Brazilian fishery during 1991. Taiwan leased vessels landed record billfish catches of about 430-470 t during 1992 and 1993 (appendix E4b3). Perhaps due to the heavy foreign fishing the Brazilian domestic fleet landed only 190-200 t of billfish in 1993-94. After the Taiwan fleet sharply reduced effort in 1994, Brazilian catches began to recover and totaled nearly 400 t in 1996. Taiwan is again increasing effort and the overall (domestic and foreign) 1996 billfish catch off Brazil set a record exceeding 700 t (appendix E4b3). The impact on future catches is yet to be determined.

The Brazilian billfish catch is not precisely a bycatch as that term is normally used in the U.S. popular press. The multi-species Japanese-style fishery which dominated the Brazilian fishery until the mid-1990s targeted billfish along with tunas, swordfish, and sharks. Billfish generated part of the revenue in the fishery.

Brazil's future management plans for billfish are unknown. The country to date has taken no management action to designate all or part of the valuable billfish stocks to recreational fishermen. The overall economic value of fish taken in the recreational fishery far exceeds that taken by commercial or artisanal fishermen. Given Brazil's substantial billfish resource, an expanded recreational fishery could potentially generate significant revenue. Brazil has a small, but still generally underdeveloped recreational fishery.[604] (See "Fleet Operations".) A major expansion of the recreational fleet would require substantial capital investment. Unlike some other South American countries, Brazil may not be able to attract large numbers of foreign anglers. Foreign participation in the fishery to date has been limited.

Both Brazilian longline fishermen and the Japanese and other foreign fishermen operating leased longliners report billfish bycatches. Most of the billfish landed off Brazil, however, is generally taken by the domestic fleet. The domestic fleet in the late 1980s and early 1990s accounted for over 70 percent of billfish landings and in most years about 80-85 percent (appendix E4b3). The influx of foreign fishermen participating in the leasing program can affect the proportion taken by the domestic fishermen. The entry of large numbers of Taiwan longliners in 1991, for example, in part caused the domestic share of the billfish catch to decline to only 27 percent by 1993 (appendix E4b3).

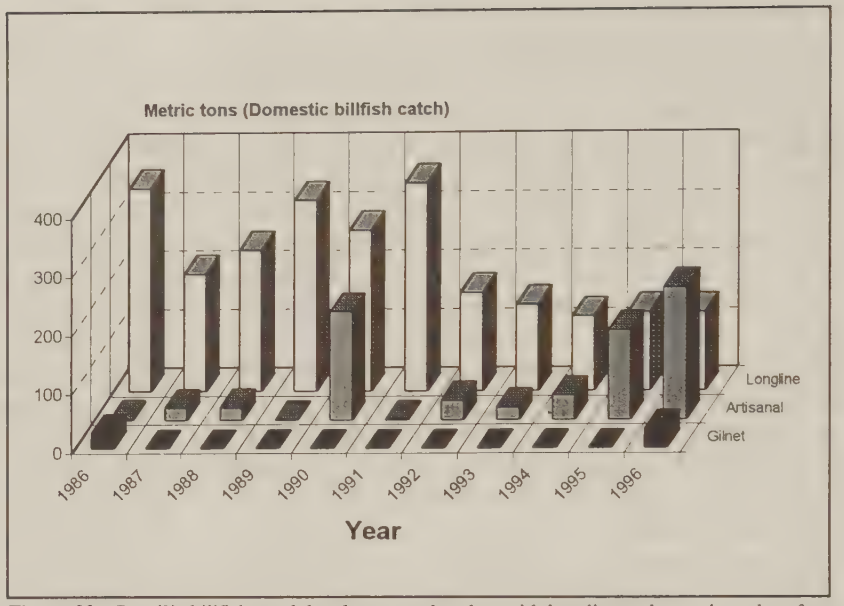


Figure 89.--Brazil's billfish catch has been mostly taken with longliners, but artisanal surface fishermen now take most of the billfish landed by the domestic fishermen.

The principal billfish species being landed off Brazil is sailfish. Sailfish normally account for more than 50 percent of Brazilian billfish landings (appendix E4b5). The species composition landed, however, is highly variable. This is probably due more to changing fishing strategies and varying participants in the fishery rather than to actual changes in the populations or availability of these species.

The longline fishery once was responsible for most of the billfish landed off Brazil. This has declined, however, as Brazilian fishermen switch from a multi-species fishery to one focusing on swordfish. In addition artisanal fishermen are increasingly acquiring gear and technology (modern gillnets) that are allowing them to catch more billfish and sharks. Artisanal gillnet fishermen are reportedly landing much higher numbers of sailfish in the mid-1990s. Longlining has generally accounted for 70-90 percent of the Brazilian billfish bycatch (1986-93), but by 1996 this had declined to less than 35 percent (appendix E4b4).

Data from the fishery exists, but two important factors should be noted in interpreting the available billfish data:

Estimates: In many cases billfish catch data are only estimates. The data from the domestic and foreign commercial longline fleet is probably more precise than is the data available on sport and artisanal surface fisheries. The artisanal data is very difficult to collect and is primarily rough estimates from local scientists and officials. As the artisanal surface fishery has become more important in recent years (appendix E4b4), the reliability of overall Brazilian catch estimates is probably declining because the artisanal data is so unreliable.

Populations: The available catch data cannot easily be used to estimate population trends. Billfish are not the main target species. Thus major fluctuations in billfish landings are probably due to changes in gear and methods for the target species and adjusting fishing strategy to target species market trends. New entrants in the fishery, such as Taiwan fishermen in 1991, can have a major impact on the species composition of billfish landings (appendix E4b5). All of this can be independent of actual population trends. Persistent multi-year trends in catches, however, may provide some evidence on stocks and abundance levels. Fishery-based data is more readily available and easy collected than fisheries-independent abundance studies. In many cases it is the only data available for attempting to assess stock levels.

Data on specific species shows that sailfish and white marlin are currently the principal species being landed. Only small quantities of blue marlin have been landed, but this may in part be due to a much reduced abundance based on sharp declines in CPUEs. Changing fishing strategies for target species, of course, could also be a factor. Notably blue marlin catches increased in 1995 and 1996 and exceeded those of white marlin in 1996.

Sailfish: Sailfish is the principal billfish species, other than swordfish, being landed off Brazil. In some years as much as 70 percent of the billfish landed are sailfish (appendix E4b5). The proportion declined to very low levels in the early 1990s--only slightly more than 20 percent in 1991. The authors are not sure why the

proportion dropped, but it appears to be associated with two factors.

Taiwan entry: Substantial numbers of large Taiwan longliners entered the fishery in 1991 (appendix A1c). The added effort on sailfish may have affected domestic Brazilian catches. The Brazilian billfish catch subsequently declined, especially the sailfish catch (appendix E4b5). Interestingly, the overall billfish catch did not decline nearly as much as the sailfish catch.

Brazilian operations: Brazilian fishermen appear to have shifted operations in some way, resulting in lower sailfish catches, but higher white marlin catches (appendix E4b3d).

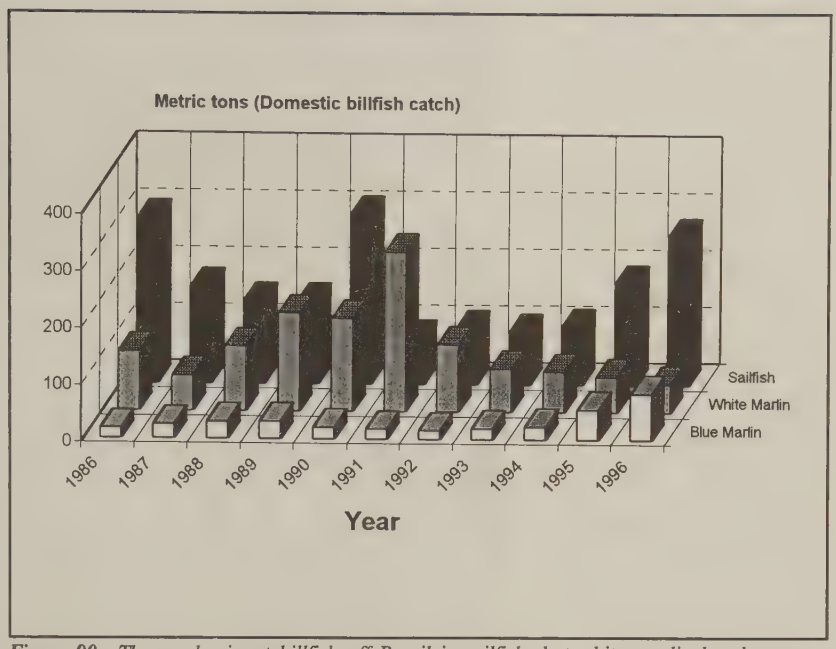


Figure 90.--The predominant billfish off Brazil is sailfish, but white marlin has been very important in some years.

Sailfish landings in the mid-1990s began to return to historic levels. The source of the landings, however, has changed significantly. Commercial longliners now account for only a small part of the landings, which are now mostly accounted for by expanding artisanal gillnetting. The artisanal fishermen like the commercial fishermen market their billfish catches domestically. ICCAT reports that Brazilian surface catches (mostly gillnet catches) of sailfish totaled 143 t in 1995 and 224 t in 1996 while the longline catch was less than 30 tons.[605] Sailfish is caught year-round along the Brazilian coast, but catches are highest in the fourth and first quarter of the year, although seasonal abundance varies somewhat by area. The highest CPUEs were reported along the central and south-central coasts from about 15°-30°S. Sailfish off Brazil appear to have a less tropical range than marlin. Abundance has fluctuated significantly. One 1992 report reported CPUE levels had been increasing since 1987.[606] This was long before the large Taiwanese vessels were deployed.

Blue Marlin: Brazilian fishermen land two species of marlin; whites and blues.[607] White marlin landings have significantly exceeded those of blue marlin. Only small quantities of blue marlin have been taken off Brazil. The Brazilian domestic fleet reported catches of only about 15-30 t through 1994, although significantly higher catches have been noted in 1995-96 (appendix E4b5). Blue marlin are being taken year-round. The largest numbers are taken off the northeast coast in tropical waters. There does not appear to be any seasonality in the northeast fishery, but higher catch rates along the central and southern coast were reported during the fourth and first quarters, the warmer season.[608] Catch rates are highly affected by the depths of the sets. Both foreign and domestic longliners often set at depths below those for optimal marlin catches.[609]

Brazilian: Brazilian longline fishermen have reported a sharp decline in marlin catches. Brazilian catch rates peaked in 1972 and after stabilizing in the 1970s through 1987 declined by 1990 to extremely low levels.[610] Brazilian catch data, however, shows a notable increase in the blue marlin catch during 1995-96. This could reflect increased availability due to increasing abundance, but the authors know of no evidence to confirm this. Two factors may be involved. One, Brazilian fishermen are expanding operations off the northeast coast where blue marlin are more abundant. Two, artisanal fishermen are expanding the surface fishery, deploying more and larger monofilament gillnets. ICCAT reports, for example, that the gillnet fishery in 1996 accounted for 21 t of blue marlin.[611]

Foreign: Foreign fishermen (Japan and Taiwan) in the south Atlantic generally during the 1970s and 80s have reported a similar overall decline in blue marlin catch rates to that reported by Brazilian fishermen, although the precise annual fluctuations vary.[612]

White marlin: White marlin has in recent years been the second most important billfish landed by Brazilian fishermen. Occasionally the catch has even exceeded that of sailfish. Brazilian domestic white marlin catches have been as high as 208 t (1991), but catches from 100-170 t have been more common. Since 1993 catches have been below 100 t and trending downward (appendix E4b5). The catch of blue marlin actually

exceeded that of white marlin in 1996. The reason for this decline is unknown but may be in part due to the lingering impact of harvesting so many fish in 1991 when several large Taiwan longliners entered the fishery. Unlike sailfish, which since 1995 are being taken in large numbers by the surface gillnet fishery, there is virtually no surface catch of white marlin. This may be because the white marlin are less coastal than sailfish and thus not as accessible to artisanal gillnets which are set in coastal waters. Brazilian domestic white marlin catches are highest in the third and fourth quarters (spring and summer), especially from October to January. Data from the leased Japanese longline fleet (the most comprehensive available data set) show catches throughout the year, but particularly during the fourth and first quarters. The Japanese reported extensive effort along the southern coast off Rio Grande and Uruguay and in tropical waters between Brazil and Africa during the warmer fourth and first quarters, but this probably reflects fishing strategy for bigeye and other target species. The Japanese reported the best white marlin catch rates along the central coast (15°-30°S) during the fourth and first quarters.[613] Historic white marlin CPUEs have also declined during the 1970s and 80s, but not nearly as severely as blue marlin CPUEs.[614] More recent data shows white marlin CPUEs along the Brazilian coast have continued to decline.[615] The Japanese reported an enormous drop in CPUEs since the mid-1960s. Taiwan fishermen reported a sharp decline during the early 1970s, but increased rates in the 1980s, although still below the levels reported in the late 1960s and early 1970s. Brazilian fishermen have reported significant fluctuations with high CPUEs in 1972 and again in 1986, but sharply declining CPUEs since the 1986 peak. Brazilian data in 1990 showed CPUEs at only 15-20 percent of the peak years.[616] The white marlin bycatch reported by the leased Japanese vessels has plummeted since 1977 when the fishery begun. The fishermen reported a marlin bycatch of over 800 kg per 1,000 hooks, but this dropped to about 150 kg in 1978-79. Since then the marlin catch rate has varied from negligible levels (1981) to about 80 kg per 1,000 hooks (1985).[617] This sharp decline may be primarily due to the shift in the fishery from northern grounds in 1977 to more southerly grounds. Marlin are more abundant in the warmer tropical waters and thus may make up a smaller proportion of the catch on the more southerly grounds where the fishery was centered during the 1980s.

Photo 182.--Brazilian longliners catch billfish along with swordfish, tunas, and sharks. These fish are being carted to the Terminal Pesqueiro in Santos. Dennis Weidner

Photo 183.--Several fisheries besides the longline fishery take sharks. These fins were provided from the bycatch of a shrimp trawler. Fred Beaudry

The Brazilian pelagic longline fishery which developed in the 1970s, primarily targeted tunas to supply the domestic market with *sashimi*-grade tunas, but took large quantities of sharks incidentally. The already existing domestic shark market, however, offered a lucrative outlet for the substantial shark bycatch of the pelagic longline fishery. The Brazilian fishermen thus retained much more of the shark catch after finning than the foreign fishermen who fish off Brazil under leasing arrangements.[619] Some Brazilian longline fishermen and companies actually target pelagic sharks. While the unit price for shark is less than that for tuna and swordfish, the catch rates are so much higher that such operations can be profitable.[620] This was especially the case by the late 1980s when substantial and growing domestic demand helped increase prices. Brazilian domestic demand in the 1990s has been quite strong. The sharks are an important part of a vessel's earnings. Sharks currently make up a substantial catch of the longline fisheries off Brazil, although results vary, depending on the fishery,

2. Sharks

Sharks are a major bycatch of Brazil's longline fishery targeting swordfish. Bycatch is not the best term because the incidental shark catch is a major source of income. This is especially true for the domestic fishermen, some of whom target sharks.

Artisanal fishermen in the 1960s initiated the country's shark fishery when they began targeting the species with demersal longlines and gillnets. Subsequently commercial trawler fishermen in the 1970s initiated shark fisheries.[618] These were important developments as it meant that a strong market for shark existed in Brazil for the pelagic longline fishermen.

Photo 184.--Tunas and shark, as well as swordfish, make up most of the Brazilian longline catch. Dennis Weidner

Photo 185.--Sharks, like this night shark (Carcharhinus signatus), are a major part of the bottom longliner catch off Paraná state. Fábio Olmos

Photo 186.--Tiger shark (Galeocerdo cuvieri) being gutted and finned after capture by a bottom longliner off Paraná state. Fábio Olmos

Photo 187.--Dock worker at Santos handling a freshly landed shark. More than half of the catch landed by Brazilian longliners is often shark--almost all of which is retained. Dennis Weidner

Photo 188.--The Brazilian longline fishery takes many sharks. Fishermen some times target shark because the returns can be quite profitable given the potential high catch rates. D. Weidner

Photo 189.--Brazilians using Japanese methods land many sharks. This and the greater number of hooks deployed means that more valuable species may not have been handled optimally. D.Weidner

Photo 190.--Shark fins are a valuable export commodity and an important part of the longline crew's earnings. Dennis Weidner

Photo 191.--Weighing a load of shark fins at the Santos Fishing Terminal. Some sharks are still finned, but a substantial proportion of the trunks are now utilized. Dennis Weidner

grounds, and longline gear. Available catch composition data shows that about half of the domestic pelagic longline catch has been shark (appendix E4c1). The foreign fishermen operating leased vessels report a much smaller proportion of sharks. The shifting focus of the Brazilian fishery with monofilament gear and targeting swordfish will undoubtedly affect the catch composition. The strong domestic market and the interest of some fishermen in setting lines targeting sharks will likely cause sharks to continue to be a major portion of the country's longline catch. Most of the shark carcasses are marketed domestically and the fins exported.

Available information on shark interactions reported by Brazilian and foreign fishermen is as follows:

Experiential longlining: Experimental shark longlining during the 1970s off northeastern Brazil reported catches composed primarily of requiem sharks (*Carcharhinus sp.*), especially "sucuri da galha preta" and tiger sharks, "jaguaras" (*Galeocerdo cuvier*) (appendix I1).

Brazilian tuna longline fisheries: Brazilian tuna longline fishermen have gradually increased their shark catches. The Santos fleet increased the shark proportion of their catch from only 16 percent in 1977 to over 50 percent in 1990 (appendix E4c2).[621] Their primary interest in sharks during the early years of the fishery were the fins for export, but artisanal fishermen had established a market for sharks during the 1960s and thus the domestic longline fishermen did not commonly discard the finned carcasses like many of the foreign fishermen. One assessment of the fishery reports that the most important species taken are blue (*Prionace glauca*) and grey "sucuri da galha preta" sharks (*Carcharhinus sp.*) (appendix I1).[622] These species reportedly constitute about 95 percent of the total shark catch. Off southern Brazil, blue sharks alone usually account for about 80 percent of the overall pelagic longline shark catch.[623] Brazilian fishermen used to fin and discard the blue shark carcasses, but most are reportedly now retained after finning.[624] Fishermen from the northeast report the same largely the same species comprise their catch. One study of northeastern fishermen targeting tunas and sharks reported catches of tuna-mostly yellowfin (30 percent), shark (54 percent), billfish (12 percent), and other (4 percent).[625] The Brazilian fishery is in sharp contrast to the U.S. longline fishery where only a few high value species are retained.[626] The great bulk of Brazil's pelagic shark catch is taken off the southern and southeastern coast. The fishery off the northeast coast is expanding , but is still small in comparison to

the larger southern fishery (appendices E4c2-3).

Other Brazilian fisheries: Sharks are also taken in other Brazilian fisheries, including both artisanal and commercial (trawlers and purse seiners). They are usually not the target species, although in many cases comprise one of many species important to a multiple-species fishery. Landings, especially by artisanal fishermen, occur in a large number of small sites. As a result, reporting tends to be spotty.[627] Some environmentalists are concerned about the high level of shark bycatches in the Brazilian fishery.[628] Sharks as most important predators have low reproduction rates and are thus often highly vulnerable to over fishing. The artisanal fishermen generally fully utilize the catch. Unlike some commercial fishermen, the artisanal fishermen are not as likely to discard the less valuable species. This is especially true in the late 1990s as catch rates have declined.[629] The only species commonly discarded is the six-gill shark, but catches of that species are not large. One observer familiar with artisanal fishermen reports that the fishermen retain their catch of blue sharks. Blue shark in 1999 can be purchased for about 1 real ($0.90) per kilogram in the artisanal fishing villages (colonies).[630] (See "Fleet Operations: Artisanal" for more details on the artisanal shark fisheries.) Commercial longliners report average sales in the domestic market during 1998 at $1.30-1.50/kilogram.[631]

Japanese-leased fleet: Several species of shark (blue, hammerhead, mako, and porbeagle) are reported as a bycatch in the leased Japanese longline vessels (appendix E2c4). Some species such as blue sharks may be largely discarded, although the authors do not have good information on this. The Japanese operating the leased vessels out of Santos have reported a very significant decline in the abundance of sharks during the 1980s. CPUEs have declined from about 325 kg per 1,000 hooks in 1983 to only about 100 kg in 1989, the last year for which Japanese data is available.[632]

Taiwan fleet: Taiwan fishermen report substantial shark catches, although the quantity retained depends on the success of the sets for the targeted species, often albacore. If the fishermen have a good albacore catch, they tend to discard more of the hooked sharks after finning. Many of the lower-value species (such as blue sharks) are discarded. The fishermen have to sometimes discard sharks as it is dangerous to have large numbers of live sharks on the deck while the crew is pulling in the line and unhooking and gutting the catch.[633]

The status of shark stocks, given the number of species and extensive length of the Brazilian coast is beyond the scope of this report. Clearly there is reason for some concern giving the increasing fishing effort, especially by artisanal fishermen. Sharks

Photo 192.--One of several shark fin loads landed by a Brazilian vessel after only a short trip. Dennis Weidner

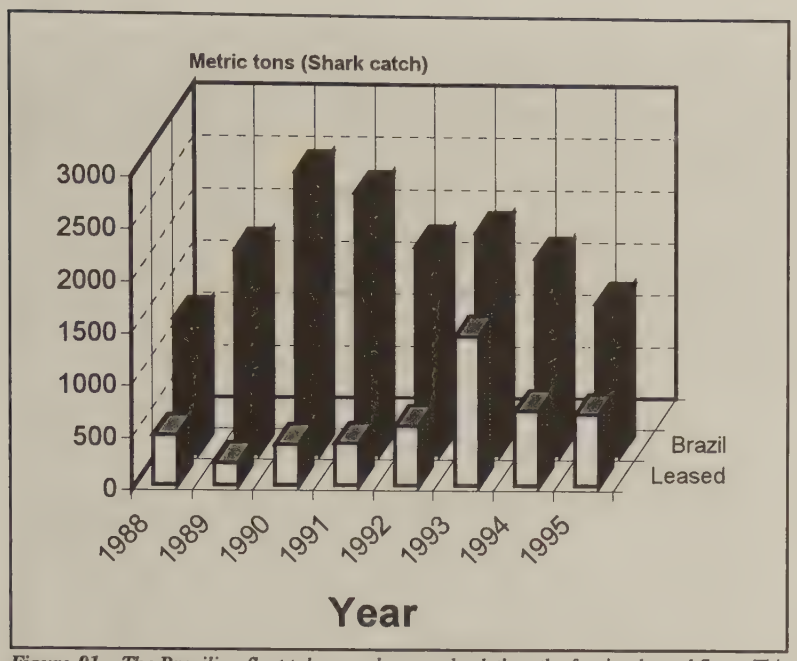


Figure 91.--The Brazilian fleet takes much more shark than the foreign leased fleet. This IBAMA data shows catches peaking in 1990, but other data shows major increases since 1994.

catches since peaking in 1990 have declined (appendix E4c1). The species most impacted by the commercial longliners is the blue shark (*Prionace glauca*) which as mentioned above is the species most prevalent in the commercial longline catch. Work on sharks at both CEPSUL and IP provide evidence suggesting over exploitation. An IP researcher studying the CPUE (sharks/100 hooks, and kg/100 hooks) and fishing effort from Santos longliners (São Paulo State), observed growing effort and increasing CPUEs during 1971-1982. Subsequently (1983-88) fishermen increased effort, but the CPUE declined.[634] CEPSUL researchers combining IP data with more recent data they have collected information, compiled the following CPUE trend line: 1976-79 (0.4 blue sharks/100 hooks), 1980-1981 (1.3 blue sharks/100 hook), 1983-1988 (6-11 blue shark/100 hooks), and 1997-1998 (2 blue sharks/100 hooks).[635] Researchers have also observed a decline in the average size and weight of the species during 1983-88. There was a decline in the average weight of 45 period during the period 1971-1988. The average size of blue sharks ranged from 2.66 m in 1971 to 2.54 m total length in 1988.[636] CEPSUL researches report that during the 1980s the national fleet has ceased discarding sharks, retaining even the smaller fish. In fact smaller hook sizes are being used to keep catch rates at high levels.[637] IP researchers used the Shaefer model (MSY model), for the period 1983-1988, when the fishery was more intensive and found an MSY of 508.5 t, with effort of 2.3 million hooks. In 1984 longliners landings reached 552. t, with an effort of 2.2 million hooks. After this period the landings have declined.[638]

3. Turtles

Brazil has one of the strongest shore-based turtle protection programs in Latin America. The Brazilian Sea Turtle Conservation Program (TAMAR) has protected the principal Brazilian turtle nesting sites since 1980. TAMAR is a federal government initiative supported by IBAMA and its predecessor agencies. TAMAR is also supported by the Fundação Pró-Tamar, a non-governmental organization.

Photo 193.--A TAMAR researcher measuring a nesting green turtle. Neca Marcovaldi

Brazilian officials have been less committed to a program protecting turtles at sea. Most environmental groups are convinced that programs to protect turtle beach nesting sites need to be combined with at-sea protection programs if turtle populations are to survive. Brazil is a signatory to the International Sea Turtle Convention. The country has a Turtle Excluder Device (TED) program designed to prevent incidental takes in shrimp trawls. The TED program is not, however, being enforced in the large southern fishery. Shrimp fishermen in the south, who market their catch domestically, are not convinced that at-sea protection is needed, or that existing TEDs are suitable for Brazilian conditions. Others say that there are few turtles off the southern coast and the TEDs are not needed.[639] Environmentalists disagree. Brazil is one of the few Latin American countries with shrimp trawl fisheries that has not implemented and enforced an effective nation-wide TED program.

Most of the Brazilian work to date on fishery interactions appears to have focused on artisanal fishermen. It is unclear to the authors why the Brazilians have focused on the artisanal fishermen. Information on dead and stranded turtles is collected by TAMAR and the agency has since surveyed the major feeding grounds where artisanal fishermen experience incidental catches.

Turtles occur widely all along the Brazilian coast.[640] Most species of sea turtles are found off Brazil, including greens (*Chelonia mydas*), loggerheads (*Caretta caretta*), leatherbacks (*Dermochelys coriacea*), hawksbills (*Eretmochelys imbricata*), and olive Ridleys (*Lepidochelys olivacea*). There is also extensive nesting at numerous sites along the coast.

A growing body of information from tag returns is providing an ever-improving understanding of turtle movements along the coast. Various groups are tagging turtles in Brazil, including TAMAR and CEPSUL.[641] The results are providing an better understanding of the populations dynamics of the various species off Brazil. Green and olive ridleys turtles tagged in Brazil have moved north in the Guianas Current to Trinidad. The Brazilians also report many recaptures of olive Ridleys and greens tagged in Suriname and greens tagged on Ascension Island. One green tagged in Brazil (Almofala) was recovered in Nicaragua. Loggerheads have been recovered in the Azores. A hawksbill tagged in Brazil has been recovered near Dakar, Senegal. In addition, a loggerhead from Western Australia have been recovered in Brazil.[642]

TAMAR has research stations at over 20 sites along the coast and on offshore islands. TAMAR has collected information on fishery interactions in coastal waters and is in the process of publishing its findings.[643] TAMAR assessments indicate that most of the sea turtle interactions are with artisanal coastal fisheries.[644] Some of the most common coastal gear are floating weirs, set nets, and fish traps. The TAMAR study is designed to identify the main threats and to help develop appropriate remediation measures, including gear modifications and fishing strategies.[645] TAMAR in 1991 began surveying important feeding grounds off Almofala (Ceará), Pontal do Peba (Alogas), Ubatuba (São Paulo), as well as areas in

Photo 194.--TAMAR researchers and fishermen releasing entangled sea turtles, which gives them the opportunity to examine and measure the reptiles. Neca Marovaldi

Sergipe, Bahia, Espirito Santo, and Rio de Janeiro states. Underwater observations are under way in Atol das Rocas (Rio Grande do Norte) and Fernando de Noronha (Pernambuco). TAMAR reports that it has been working with the artisanal fishermen to reduce interactions and nearly 99 percent of the turtles taken are released alive.[646] The low income levels of many artisanal fishermen means releasing a turtle, or refraining from taking one, is a difficult choice involving a financial sacrifice. TAMAR reports that it has a strong community program to work in fishing villages. Tamer researchers interact closely with the fishermen and communities as a whole, developing initiatives and activities directly benefiting the communities and providing economic alternatives.[647]

Little information is available on turtle interactions with the commercial longline fishery off Brazil. Some information has been developed by TAMAR and the IP, but the results differ. One TAMAR study suggests very high rates of interactions with the commercial longliners.

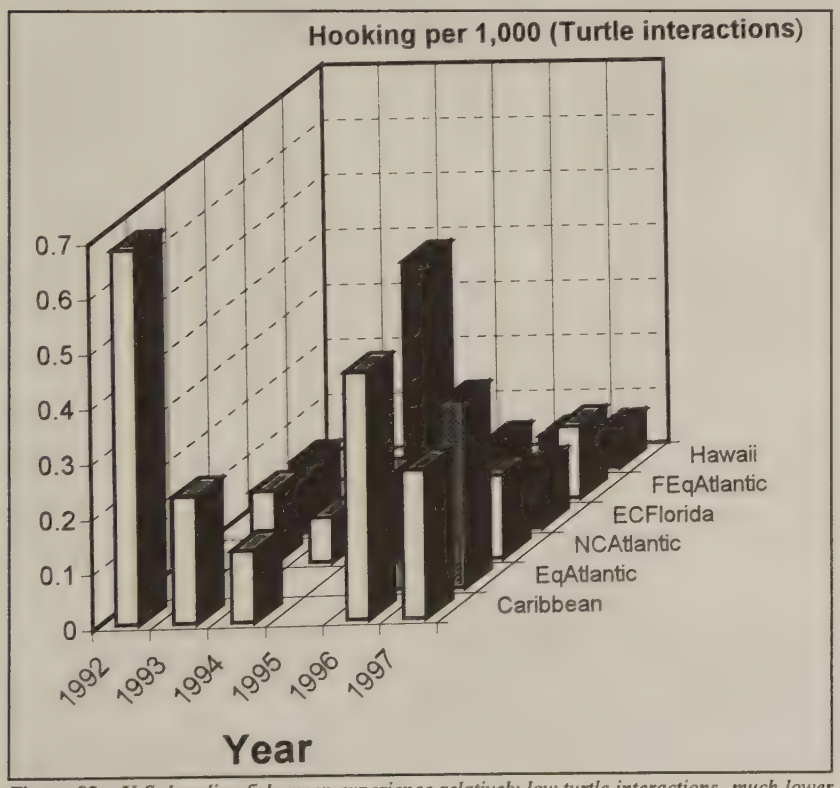


Figure 92.--U.S. longline fishermen experience relatively low turtle interactions, much lower than some of the levels reported by Uruguayan observers.

TAMAR: TAMAR has focused on the coastal, largely artisanal fishery.[648] Similar research or published reports on the commercial fishery are not available. TAMAR has, however, begun to assess commercial longline interactions off southern Brazil. TAMAR in 1998 completed an assessment of interactions with loggerhead turtles, based on observations aboard a domestic commercial longliner operating primarily beyond the 200-mile limit, off the southern coast. Data was obtained for only nine sets, but they suggest a very high rate of interactions--much higher than in comparable U.S. fisheries (appendices E5a1-2).[649] TAMAR plans additional research on this subject.[650] Data has been obtained from two other longliners and TAMAR researchers are currently analyzing it to determine if the data previously obtained, especially the rather high levels of interactions

were representative for the fleet as a whole.[651]

IP: The IP indicates that the fishermen operating out of Santos rarely report interactions with turtles. Occasionally the longline fishermen report very small incidental catches. The turtles appear to be attracted by the bait. One IP researcher stresses that the turtle bycatch is probably very small.One IP researcher believes that over 90 percent of the turtles taken are returned live to the sea, most of the others or discarded dead.[652]

Scattered reports from Brazilian fishermen also indicate interactions of several turtle species with fisheries. Small numbers of interactions with green, leatherback, and loggerhead turtles have been reported in the coastal shark fishery.[653] One observer reports very limited interactions between demersal longliners and turtles.[654] The authors know of no thorough studies assessing the level of the sea turtle bycatch off Brazil. One Brazilian observer reports interactions with leatherbacks.[655] Some observers believe that there may be a relatively high rate of interactions, based on available data from Uruguay (Uruguay, appendix D6b1). Operations off southern Brazil should have similar turtle bycatch rates to those off neighboring Uruguay. Operations off northeastern Brazil may have even higher turtle bycatch rates than in the south because of the greater abundance of turtles.

No data is available on the survival rates of the turtles released alive. The fishermen report that the larger turtles can often be returned live to the sea and that only the smaller turtles die.[656] Other researchers believe that a substantial number of the turtles released alive may eventually die. TAMAR researchers indicate that while they have no way of measuring the survival rate, they fear it may be relatively high. Many turtles are released with serious wounds to the mouth and throat. This is largely due to careless handling by the crews who are rushed to handle the catch as it is being brought aboard. One TAMAR researcher reports his belief that, "Many will probably die in a short time."[657]

Some information is available from foreign fishermen which provides insights into possible turtle interactions off Brazil:

Japan: The authors know of no published Japanese studies on the bycatch they experienced in operations off Brazil. As the Japanese have conducted an extensive distant-water fishery over nearly four decades, the absence of Japanese data is a serious impediment to a comprehensive assessment of the

Photo 195.--NMFS gear specialists have worked with Brazilian shrimp fishermen to help initiate a Turtle Excluder Device (TED) program. Fred Beaudry

Photo 196.--Many turtles like this loggerhead hooked by a longliner off southern Brazil are unlikely to survive, in part due to rough handling by crews. Venancio G. de Azevedo

bycatch problem off Brazil.

Spain: Spanish researchers have done some work on leatherbacks and other turtles, but the results could not be obtained by the authors in time for publication of this report.[658] Spanish research on the longline bycatch has involved more work on turtles than any other species.[659] Spanish researchers have focused their work on turtles at equatorial latitudes, but in the eastern Atlantic off Africa rather than the western Atlantic off Brazil.[660] They have noted substantial interactions, which suggests the likelihood of some turtle interactions in the Brazilian longline fishery.

Taiwan: Taiwan longline fishermen also do not report turtle interactions.[661] This appears unusual and the authors cannot confirm from independent sources that there are no turtle interactions. Albacore fishing in cooler waters may have lower turtle interactions. Some of the Taiwan albacore fishery, however, is in tropical waters.

United States: U.S. longline fishermen operating in the northern hemisphere report turtle interactions.[662] While data is generally lacking, U.S. longline fishermen have reported some limited effort off Brazil. Observations from that effort are very limited and are still an inadequate basis for valid conclusions. The few observations indicated a level of interactions in 1996 of 0.5 turtle hookings per 1,000 hooks, a low level compared to the level reported in the U.S. Hawaiian longline fishery and but much less than reported along the U.S. eastern coast. Results in 1997, however, suggested a higher level of interactions (appendix E5a1).

Uruguay: Uruguayan researchers based on at-sea observations have noted relatively high loggerhead and leatherback interactions off Uruguay and in offshore areas off southern Brazil and Uruguay (Uruguay, appendix D6b1).[663] Southern Brazil is adjacent to Uruguay and oceanographic conditions, such as seas-surface temperatures, are similar (figures 31-35). Thus interaction rates off southern Brazil and Uruguay are likely to be very similar.[664]

4. Small cetaceans

There is no comprehensive study of the interactions between the Brazilian longline fishermen and marine mammals. The principal marine mammals encountered off Brazil are small cetaceans. Some of the species which most commonly interact with the longline fishermen are killer, false killer, and pilot whales and Riso's and spotted dolphins.

Some researchers report minimal interactions based on informal discussions with the fishermen. The IP, the most active Brazilian research institute working on swordfish, does not report any bycatch of small cetaceans in fishing operations off south and central Brazil.[665] The authors know of no published study by any other Brazilian research institutes with data on the level of interactions experienced.

The only available information on interactions with small cetaceans that the authors have been able to obtain is scattered anecdotal accounts from fishermen. Artisanal fishermen and officials working with the fishermen report very few sightings of marine mammals in coastal waters.[666] There are interactions with the commercial longline fishermen, but the level of those interactions is unknown. One commercial fisherman reported that spotted dolphins occasionally get entangled in lines. Other observers report minor problems with pilot and killer whales and Risso's and spotted dolphins being occasionally caught. These species less commonly also get hooked while feeding on the bait (usually squid).[667] Teuthofagous or squid eating species are probably more affected than those feeding on other species. Several Brazilian sources described to the authors how the whales get entangled in the lines, or less commonly accidentally hook a fin or tail fluke.[668] Most of the marine mammals entangled probably suffocate because the weight of the line and catch will make it difficult for them to surface so they can breathe.[669] Such mortalities could be increasing as Brazilian fishermen turn to monofilament line, which is more difficult for marine mammals to see and thus avoid.[670] On the other hand, the monofilament gear is lighter and thus somewhat easier for an entangled animal to bring to the surface. Relatively shallow sets for swordfish may result in more marine mammal interactions. The increasing use of light sticks and squid baits are other factors which may affect interactions with marine mammals.

Brazilian fishermen report problems with killer whales and false killer whales damaging their catch.[671] (See: "Other problems" below.) The whales can ruin an entire night's catch. As a result the fishermen sometimes shoot at them.[672] The number of whales killed, however, is apparently very small because the whales have reportedly learned to not approach the fishing boats too closely.[673]

Some limited information is available from foreign fishermen:

Japan: The authors know of no published accounts on Japanese longline interactions with small cetaceans or other marine mammals.

Spain: Spanish researchers have worked on cetaceans but the authors have been unable to obtain details on their work in time for inclusion in this report.[674] Some preliminary information suggests that there are very few cetaceans taken in the longline fishery.[675] One Spanish researcher reports that he is currently preparing an assessment of cetacean interactions in the longline and other fishery.[676]

Photo 197.--The Japanese fishing method resulted in quite a varied catch of swordfish, tunas, billfish, sharks, oilfish and other species. Dennis Weidner

Taiwan: Taiwan fishermen also report no incidental catches of dolphins.[677]

United States: U.S. longline fishermen report some limited marine mammal interactions in fisheries off the United States, mostly pilot whales which like the killer whales prey upon the longline catch. The U.S. interactions, however, are highly localized.[678]

Interactions off Brazil with small cetaceans may have been more serious in the 1980s and early 1990s. Some speculate that the Japanese-style longline methods then in use by Brazilian fishermen may have resulted in higher mortalities than U.S.-style gear.[679] The more shallow sets and the multi-filament line, however, may have reduced the chances for such interactions. Brazilian researchers report that it is not possible to assess the impact of longline interactions. Not only is data lacking on such interactions, but virtually no data is available on populations of marine mammals in the southwestern Atlantic.[680]

5. Large cetaceans

The authors have been unable to acquire any information on interactions with large cetaceans. Our general impression is that such interactions are not significant. None of the companies that we spoke with mentioned such interactions, while many mentioned the problems they were having with killer whales and other small cetaceans. North American sources report fishery interactions with large cetaceans off the north Atlantic coast with gillnets and cetacean pots being some of the major problems.[681] The authors, however, know of no assessment of this problem off Brazil.

6. Pinnipeds

Pinnipeds off northeastern Brazil are relatively rare and there are virtually no interactions with longlines.[682] Pinnipeds are more common off southern Brazil and Uruguay because there are breeding colonies of pinnipeds at various sites along the Uruguayan coast.[683] The interactions appear to be primarily with artisanal fishermen who operate close to the coast. No information is available on interactions with commercial longliners in offshore waters off southern Brazil. The pinniped populations are much larger in Uruguay and as a result the interactions may be more important in the Uruguayan fishery, although the principal interactions may be primarily with the artisanal fishermen or the commercial trawler fishermen.[684]

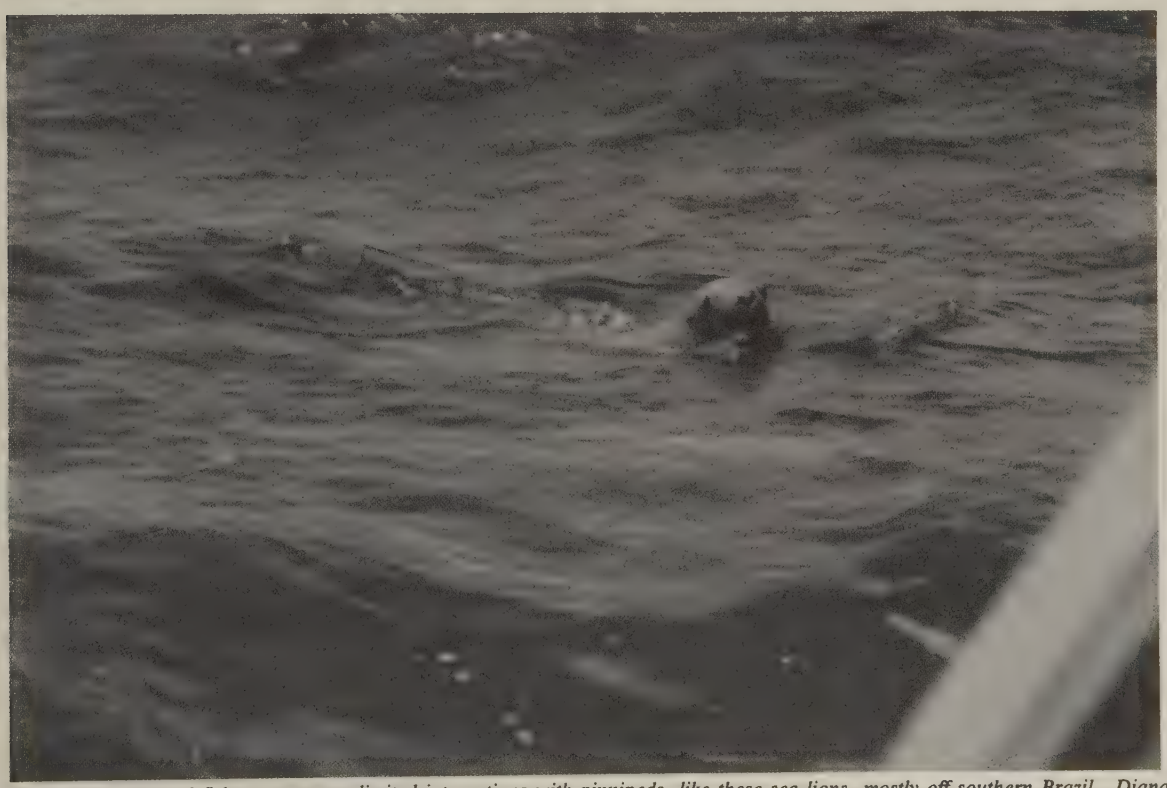


Photo 198.--Coastal fishermen report limited interactions with pinnipeds, like these sea lions, mostly off southern Brazil. Diana Szteren

7. Other species

Several other species are commonly taken in the Brazilian pelagic longline fishery. Several of these species have commercial value. The most important of these species are oil fish and less commonly opahs.

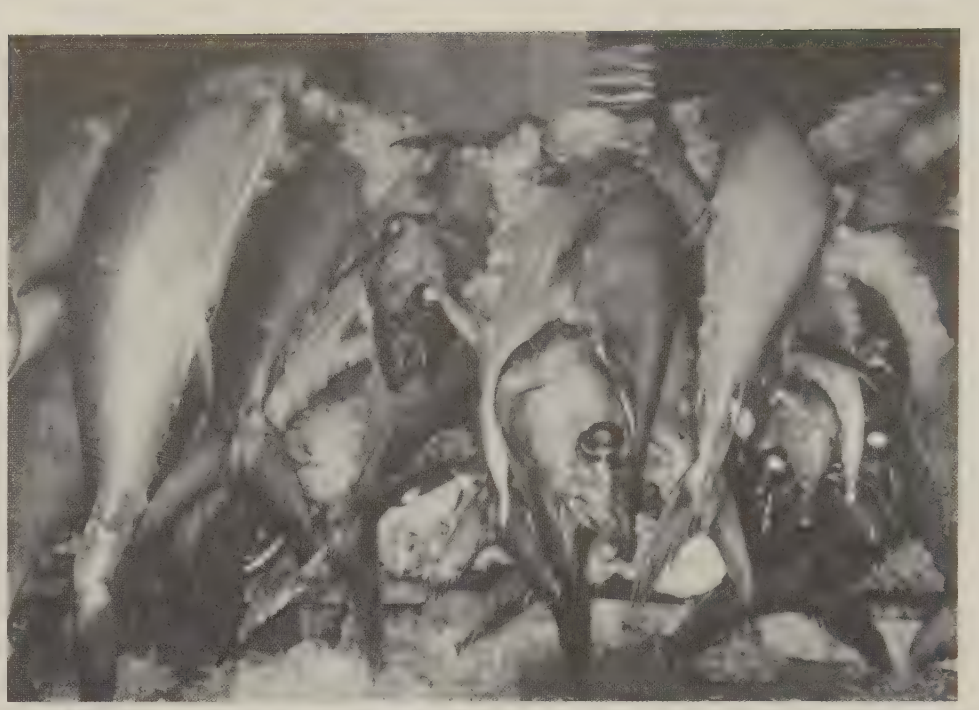


Photo 199.--Oil fish are landed along with several other species, sometimes in considerable quantities, as part of the longline bycatch. Dennis Weidner

Oil fish: Some Brazilian longline sets result in substantial numbers of oil fish (*Ruvettus pretiosus*). Oil fish are one of about 50 species of snake mackerels. It is widespread in the Atlantic, especially in deep tropical waters. This species has no export value, but it is much appreciated in the domestic market. Brazilian sources say that oilfish can be used to produce a

Photo 200.--Brazilian researchers worked on Japanese longliners that operated in association with domestic companies. These researchers in the 1980s are examining an opah. Nelson da Silva

particularly tasty cured product.

Opah: Opahs or moonfish (*Lampris guttatus*), like swordfish, occur worldwide. They can reach a length of 2 m and may weigh more than 225 kilograms. The opah is a beautiful fish and the small number taken attract considerable attention. Most are solitary individuals taken near the surface. Opah makes excellent bright orange fillets, which are highly prized by Brazilian consumers.[685] Opah have been cured and sold as other species such as smoked salmon.[686]

Photo 201.--Opahs are another species taken as part of the longline bycatch, especially when Japanese methods are used. Dennis Weidner

Wahoo: Small quantities of wahoo (*Acanthocybium solanderi*) are also reported as part of the bycatch and are easily sold in the domestic market. This is another cosmopolitan species and is highly prized by sport fishermen. They average about 10 kg, but can exceed 70 kilograms. Wahoo do not commonly school, but they do seasonally assemble in large numbers.

Photo 202.--Small quantities of wahoo are taken incidentally in the longline fishery off northeastern Brazil. Dennis Weidner

8. Seabirds

Environmentalists worldwide are increasingly concerned about sea bird mortalities in the longline fishery. One report by the environmentalist group BirdLife concluded that, "Longline fishing represents the most pervasive threat to seabird populations across the world's oceans."[687] Bird interactions occur in several ways; the most serious interaction is that birds go after the bait as the hooks are baited and the line set.[688] Many birds are scavengers and thus "preprogrammed," as one specialist put it to go after bait. Bird bycatches are closely related to the time when the lines are set (appendix E5b2). Smaller numbers are killed when the lines are hauled in. Given the number of baited hooks set, the potential impact can be significant. There is a financial enticement for the fishermen to address this problem because of the substantial cost from bait lost to the birds.[689] Given the high cost of bait in Brazil and even larger real cost of lost fish because of baitless hooks, this is a potentially serious problem (appendix D4b1).

Many experts believe that the major bird mortalities occur in fisheries in cold waters and high latitudes, in part because of larger bird populations. The problem off South America thus appears to be most severe in the colder waters along the southern (Patagonian coast) of Argentina and in sub-Antarctic waters.[690]

Only limited information is available on seabirds off Brazil and their interactions with fisheries. One of the problems appears to be an incomplete inventory of the seabirds which occur off Brazil and the areas and seasons in which they are present. Such data would help corroborate the presence of the birds during specific fishing seasons. FURG researchers are currently assessing the distribution and abundance of seabirds along the Brazilian coast.[691] Accounts from Brazil on sea bird interactions vary and there is little actual data. Information on the fishery off the northeast is particularly limited, but there has been some research carried out on the longline fishery along the country's southern coast.

a. Northeastern coast

Little published information exists on seabird interactions in tropical waters around the world.[692] The general consensus appears to be that seabird interactions with fisheries in tropical waters, with the

Photo 203.--Shrimp trawlers can often be observed being followed by terns, boobies and frigate birds, like this trawler operating along the coast of São Paulo. Fábio Olmos

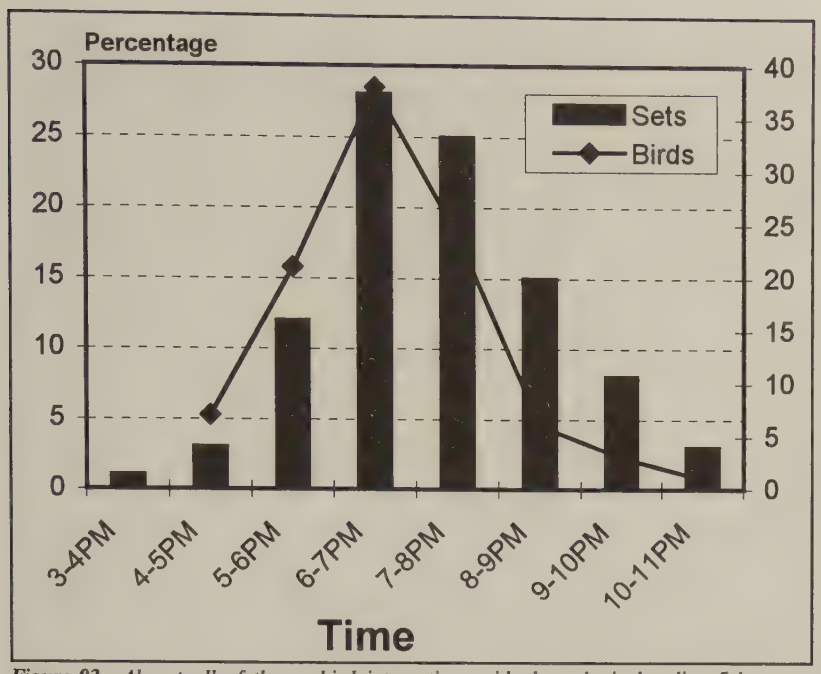


Figure 93.--Almost all of the seabird interactions with the pelagic longline fishery are reported from 5-9 pm while the lines are being set.

exception of some specific species, are not nearly as massive as in the southern oceans and, with some qualifications, not of great concern.[693] This is, however, only a preliminary assessment which requires further investigation to confirm.[694]

The authors know of no published studies on fishery/seabird interactions off northeastern Brazil. Some fishery sources reported that they are not extensive.[695] An artisanal longline fisherman working off the northeast confirms that there are few bird interactions. He reports seeing no albatrosses but a few boobies, "atobas" (*Sula leucogaster*), follow the boats.[696] One observer in northeastern Brazil reports very limited bird interactions. Some birds are sighted around the offshore islands, but interactions with the longliners are reportedly rare.[697] A UFRPe graduate student working with longline fisheries also reports that birds are relatively rare and most of the sightings are boobies--especially near Fernando de Naronha and other offshore islands.[698] An artisanal fisherman working a small longline from São José (near Recife) reports that he sees few seabirds and there are occasional mortalities of boobies.[699] An Australian researcher working at UFRPe reports that he sees few seabirds of any kind in coastal waters or even along the shore.[700] A UFRPe student working with the artisanal fishermen reports that there is a population of atobas at the Island of Fernando de Noronha, but that interactions with longliners or with artisanal fishermen are very limited. A fisheries engineer trying to introduce new gear such as longlines to artisanal fishermen also reports few bird sightings in coastal waters.

Very limited information is available on Caribbean interactions to the north of Brazil and in adjacent Atlantic waters.

Caribbean islands: Little information is available on bird interactions with Caribbean longline fisheries, but anecdotal reports suggest that such interactions are limited.[701]

Japan: The authors know of no published research.

Spain: Spanish sources report seabird interactions in their longline fishery, but the authors have no specific reports on Spanish operations off Brazil.[702]

Taiwan: The authors know of no published research.

United States: A small number of observers work on U.S. longline vessels. The focus of their work has been on marine species, finfish, turtles, and an occasional cetacean. Seabirds have also been reported, but the identification of the species involved has often been inadequate. More attention is now being given to identifying the specific species encountered. The

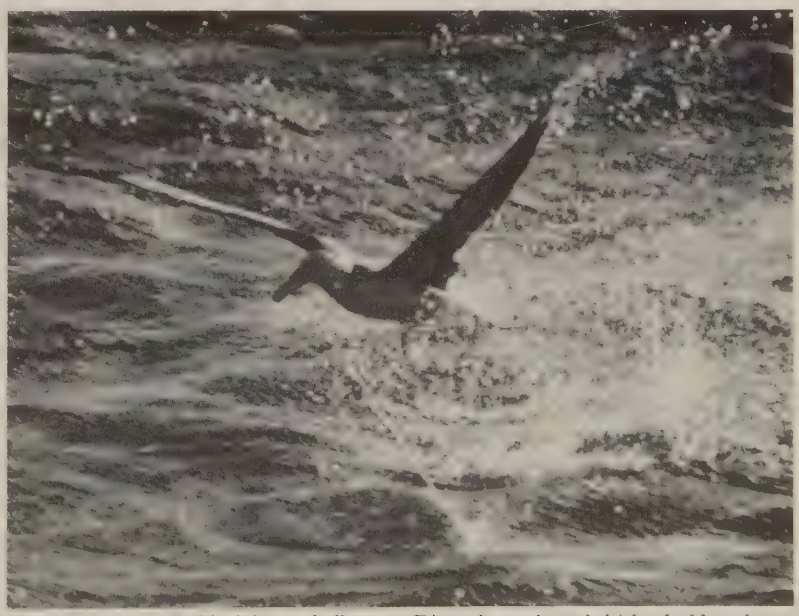


Photo 204.--Juvenile black-browed albatross (Diomedea melanophris) hooked by a bottom longline while setting off São Paulo. Fábio Olmos

limited available data at this time suggests that Caribbean and south Atlantic fishing at equatorial latitudes results in very few bird interactions.[703] The authors stress, however, that the lack of data make this only a very preliminary assessment.

Venezuela: The authors know of no study of seabird interactions in the longline fishery conducted by neighboring fishermen. Scattered anecdotal accounts suggest that interactions with seabirds are minimal, although this assessment is far from conclusive.[704] Some environmentalists, however, are concerned with the indirect impact of an expanding tuna longline fishery on shearwaters and Bermuda petrels.[705] The birds feed on pelagic finfish and squid which the tuna drive to the surface when feeding. The impact of expanding longline fisheries targeting tuna and swordfish is unknown.[706]

b. Southern coast

Some limited information is available on fishery interactions with seabirds off southern Brazil. The data, while still limited, suggests that the Brazilian tuna/swordfish longline and other fisheries may be having a significant impact on specific migratory bird species. Relatively high bycatch rates have been reported in the tuna/swordfish longline fishery off southern Brazil.[707]

Several studies exist on seabird interactions with longlines fisheries off the southern coast. One assessment of pelagic longlining covering 52 fishing days in 1987-90 noted 71 bird mortalities, mostly white-chinned petrels (58 birds).[708] Based on those observations, the observer estimated that about 2,650 birds were being killed annually by tuna/swordfish longlining off southern Brazil.[709] Another observer reported 118 seabirds killed in swordfish operations, during the 1994/95 fishing season.[710] The mortalities were highly seasonal; about 95 percent of the mortalities from the pelagic longline fisheries occur during the southern hemisphere winter months, especially July and August (appendix E5b1 and figures 41 and 42). One study conducted in the southern fishery suggested that bird interactions were primarily along the south-central coast, but this was in part due to the greater effort deployed there (figure 42). A variety of seabird species were involved, but mortalities of juvenile black-browed albatrosses were particularly notable.[711] Another more recent study conservatively reported seabird bycatch rates in the pelagic longline fishery at 0.12 birds per 1,000 hooks and albatrosses were over 70 percent of the birds caught.[712] Demersal longlining resulted in even higher bycatch rates, but a different species mix.[713] Most of the albatross mortalities (black-browed and yellow-nosed) are females. Catch rates appear relatively low, apparently because of the nighttime sets.[714] One report suggested the southern tuna/swordfish longline fishery has substantial interactions with albatrosses (black-browned and yellow-nosed) and white-chinned petrels.

The two groups of species of greatest concern to environmentalists appear to be albatrosses and petrels:

Albatrosses: Albatross concentrations are particularly notable off southern Brazil and Uruguay. As noted above, pelagic longline interactions with albatrosses can be significant. The interactions off Brazil, however, are highly seasonal (appendix E5b1).[715]

Petrels: One species (spectacled petrel) is endangered and appears to have only one breeding location. Some environmentalists consider it to be the species most at risk from longlining.[716] Environmentalists are also concerned about the white-chinned petrel.

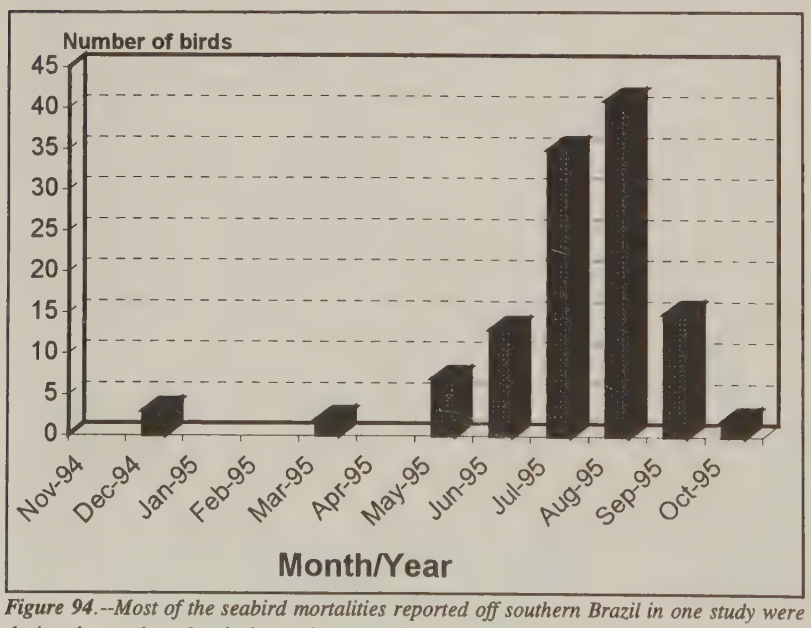


Figure 94.--Most of the seabird mortalities reported off southern Brazil in one study were during the southern hemisphere winter months, especially July and August.

Photo 205.--Yellow-nosed albatrosses and spectacled petrels feeding on a floating dead tilefish unhooked from a longline off Santa Catarina. Fábio Olmos.

Some of the sea bird species involved are highly migratory and may be subject to adverse impact from several fisheries. Environmentalists are especially concerned about wandering albatrosses in this regard. They breed on South Georgia and are affected by the expanding demersal longline fishery in the south Atlantic targeting toothfish and other species.[717] They are also affected by tuna/swordfish longline fisheries in the Brazilian subtropics and other countries.[718] Interactions with birds are reported in demersal Brazilian longline fisheries (tilefish, shark, grouper, and others). Many of the same bird species are interact with the pelagic longline fishery (yellow-nosed and black-browed albatrosses, white-chinned and spectacled petrels, and great shearwaters).[719]

Little foreign data exists to add to the Brazilian research. Some data, however, is available from neighboring Uruguay. The lack of data from the relatively extensive Japanese, Spanish, and Taiwan fisheries is a serious problem in reaching a full understanding of the level of seabird interactions.

Japan: The authors know of no published reports on seabird interactions off southern Brazil.

Spain: The authors know of no published reports on seabird interactions off southern Brazil.

Taiwan: The authors know of no published reports on seabird interactions off southern Brazil.

Uruguay: Substantial albatross mortalities are reported in the adjacent Uruguayan swordfish/tuna longline.[720] This confirms the reports from southern Brazil. Further north (north of 15°S) interactions are reported with other species of albatrosses.[721]

Some environmentalists are convinced that the long-term solution to the fishery/seabird problem appears to be basic changes in vessel design.[722] Some new longliners deployed in demersal fisheries can deploy the line from the vessel under water. Such designs may be possible in pelagic longline fisheries. Some U.S. specialists, however, caution that the longer ganglions used in the pelagic fishery may make this more complicated.[723] Modifications of existing gear and methods, however, can significantly mitigate seabird mortalities. Some environmental groups believe there is a special need to expand existing observer coverage and the use of mitigating measures to African and Latin American countries, including Brazil.[724] Brazilian researchers are currently testing "Birdline" developed by Tasman Wildlife Services to assess its success in reducing both bird mortalities and bait loss, which would be a financial benefit to the

fishermen.[725]

B. Other Problems

Brazilian fishermen report increasing interactions by killer whales and false killer whales. The whales off Brazil feed on hooked fish as has also been reported in other areas. The hooked fish provide a much easier and safer method of feeding than attacking fast-swimming tunas or a powerful predator like a swordfish. A swordfish could severely damage a killer whale with its bill. These species, especially swordfish, do not appear to be major prey items of either killer or false killer whales. The fish hooked by the longliners, however, have proven to be a great feeding opportunity for the whales--a virtual undersea seafood buffet of tasty prey they could normally only take with great difficulty.

The whales feed on the hooked carcasses, leaving only the heads, never ingesting the hook.[726] Some observers confirm that the whales reportedly prefer swordfish. Observers vary somewhat concerning their attraction to other species taken on the longlines. One observer reports that they also eat tuna and sharks.[727] Another observer indicates that they sometimes feed on bigeye, but they do not feed on yellowfin (probably because of its small size) or shark (either because of the rough skin or high urea level in the flesh). One researcher in the northeastern fishery reports that the whales prefer the tunas and rarely eat sharks.[728] Accounts from Uruguayan fishermen also suggest various preferences on the part of whales.[729]

Both Brazilian and foreign fishermen report that killer and false killer whales will feed on the hooked catch before it can be boated. The authors know, however, of no detailed study of whale interactions with the swordfish fisheries. Brazilian scientists at the Rio Grande Marine Mammals Lab are preparing an assessment of this problem.[730]

Brazil: Brazilian fishermen in both the northeastern and southern fishery have reported problems with killer and false killer whales. Researchers at the Universidade de São Paulo have surveyed Brazilian fishermen on this problem.[731]

Japan: The authors know of no published Japanese research on interactions with cetaceans off Brazil.

Spain: Spanish fishermen report similar problems. Some reports have been published, but not addressing the situation off Brazil.

Taiwan: Taiwan fishermen operating off Brazil also report problems with the killer whales.[732]

Uruguay: Uruguayan fishermen report extensive interactions with killer whales.[733]

The pelagic longline interactions with killer and false killer whales appear especially severe when the fishermen target swordfish. This is presumably because of the shallow depths at which the hooks are set.[734] Some fishermen report their entire catch has been lost.[735] The false killer whales appear to be more of a problem off the northern coast (north of 20-23°S) while the killer whales are more prevalent along the southern coast (south of 23°S).[736] Another observer reports that these interactions primarily occur along the southern coast (south of 20°S) because both killer whale and swordfish populations are larger.[737] The fishermen are convinced that some pods of killer whales have learned to follow the longliners for an easy meal. Some pods apparently have learned to listen for the vessels, either the sounds of the motors or more likely the sonar pings.[738]

Longline captains have devised various strategies to fool the whales. Companies with more than one vessel report that they sometimes use one longliner to draw the whales away from other vessels.[739] The pods always seem to stay together, normal behavior in these highly social animals. Thus, if a group of vessels split up, the whales will only follow one vessel or groups of vessels. In many cases the only way to resolve the problem is to simply leave the area.[740]

XVI. International

A. International relations

1. Bilateral

Several countries have operated or expressed an interest in operating distant-water vessels off Brazil. The Brazilians have discouraged such operating and instead encouraged foreign fishermen to consider joint-venture or leasing arrangements with Brazilian companies. The primary country negotiating leasing arrangements with Brazilian companies has been the Japanese. This is not only because the Japanese have conducted the most extensive longline fishery in the south Atlantic, but also because of the extensive involvement of Brazilians with Japanese ancestry in Brazil's fishing industry, easing the way for Japanese fishing companies to do business in Japan. As a result, until 1990 only Japanese fishing companies participated in the Brazilian leasing program. It was not until 1991, however, with the entry of the Taiwan fishing companies, that significant numbers of leases were signed for significant numbers of foreign longliners. Japanese vessels are now only a small proportion of the leased vessels.

Photo 206.--The Japanese have also played an important role in the live-bait pole-and-line fishery for skipjack.

It is not clear who was responsible for this shift from Japanese longliners to longliners from Taiwan and other countries. Brazilian sources suggest that the initiative for these leases has primarily come from the foreign companies and fishermen. Few Brazilian companies have aggressively recruited foreign companies operating longliners. Thus the decisions appear to have been based on factors affecting the foreign owners of longliners, such as domestic access quotas, domestic and foreign prices, operating costs, domestic labor and regulatory regimes, and several other factors.

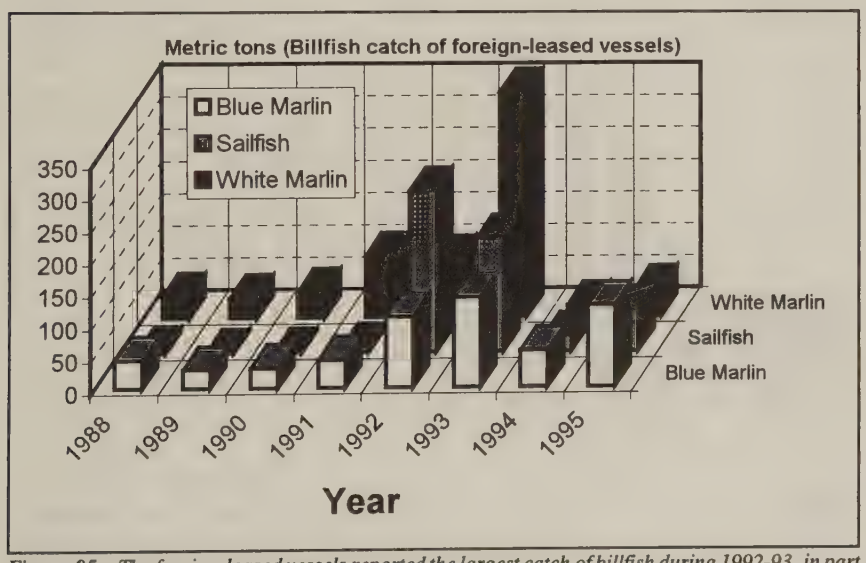


Figure 95.--The foreign-leased vessels reported the largest catch of billfish during 1992-93, in part because of increased fishing effort.

One factor to note is that the foreign-leased catch off Brazil is substantial. In some years the foreign vessels take more swordfish than do the domestic vessels. The bycatch is also substantial, although it is determined by the specific fishing strategies of the individual countries. The Japanese have focused more on tunas than have the Brazilians. The foreign fishermen are generally less interested in shark than are the Brazilians, but given the extensive effort deployed, the catch is sizeable. There could also be substantial interactions with

seabirds, but observer data is limited. As with swordfish, the foreign-leased vessels take substantial quantities of billfish--in some cases more than the domestic fishermen. In addition, these countries operate many vessels on the high seas in the south Atlantic. In most cases the highseas operations are much more extensive than the vessels operated under Brazilian leases. Some of the countries like Japan have focused on the eastern south Atlantic off Africa, but other countries such as Taiwan have focused on the western south Atlantic off South America.

Photo 207.--Japanese-Brazilians play a major role in catching, processing, buying, and marketing, especially in the longline fishery. Dennis Weidner

Some details are available on the foreign operations off Brazil. The major distant-water countries have participated in the leasing program as well as operated on the high seas beyond the Brazilian 200-mile EEZ. Details on the foreign operations include:

China: China initiated south Atlantic longline operations in 1997. They reported a swordfish catch of 30 t (appendix E3a1). No information is currently available on their south Atlantic operations.

Cuba: Cuba has been active in the south Atlantic although catches have varied widely from year to year. Record swordfish catches of 1,200-1,300 t were reported in the south Atlantic during 1984 and 1985. The Cubans primarily operated in the eastern Atlantic off Africa at tropical latitudes, but they were probably conducted in the eastern south Atlantic off Africa, and transshipped through the Canary Islands. Catches declined after 1995, in part because of fuel shortages when the Soviet Union begun curtailing shipments of subsidized oil. Because of the configuration of the African and Brazilian coasts, some of the catch may have been taken relatively close to Brazilian waters. Catches in 1994 increased to 500 t and 640 t, but were less than 100 t in 1996 and 1997.

Honduras: The Honduran Government registers a large number of foreign flag-of-convenience vessels.[741] Honduran longliners have been observed in the south Atlantic and some of the

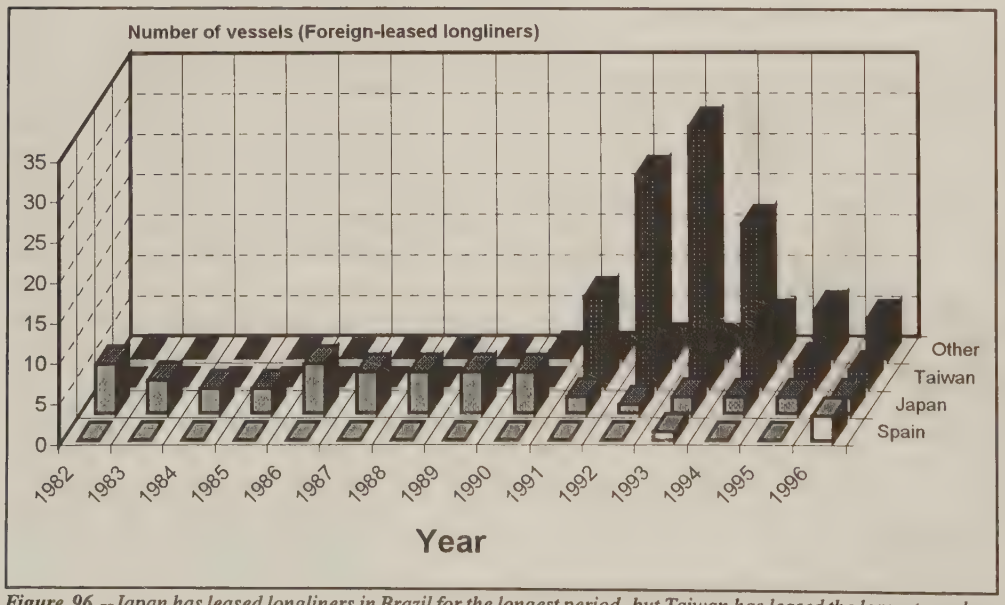


Figure 96.--Japan has leased longliners in Brazil for the longest period, but Taiwan has leased the largest number. Spain in 1997 and 1998 reportedly increased the number of leased vessels.

vessels participate in the Brazilian leasing program (appendices E3a1 and E4b3), but the authors know of no comprehensive assessment of Honduran operations.

Japan: Japanese longliners conducted exploratory fishing off Brazil in 1955.[742] A Brazilian company initiated a longline fishery for tuna and tuna-like species in 1956 out of Recife by leasing a Japanese longliner.[743] One report indicated that by 1961 there were 60 Japanese fishing vessels operating off northeastern Brazil.[744] The Japanese made research results from the *Toku Maru* during the late 1950s available to Brazilian authorities.[745] The Taiyo company was one of the most active Japanese fishing companies during the early stage of the fishery which focused on skipjack tuna. A variety of Japanese vessels were deployed including longliners and pole-and-line vessels. The Japanese worked extensively with Japanese fishermen under a variety of legal regimes. The Japanese reportedly withdrew from Recife during the 1960s due to "political and economic pressure."[746] Some leasing activity continued and this expanded with new regulations issued in 1976. During the 1980s, the principal focus of the Japanese was skipjack and several pole-and-line vessels were deployed.[747] The Japanese focus has since shifted to other tunas and swordfish as they increasingly concentrate on longline operations. Japanese distant-water longline fishermen reported substantial effort along the coast of Brazil, especially off southern Brazil during the 1960s. Japanese fishing in the 1980s has focused mostly on the eastern south Atlantic off West Africa (figures 3, 5, and 6). The Japanese often report some activity off southern Brazil and Uruguay and off northeastern Brazil, but their primary focus is operations off Africa. No fishing at all off Brazil has been reported in some years.[748] The Japanese have in recent years pursued policies designed to make their distant-water fishermen independent of coastal countries. As a result, many Japanese longliners operate without making local port calls. Supplies are delivered to the longliners by dedicated supply vessels and the catch is transshipped at sea. A small number of Japanese longliners have been involved in the Brazilian leasing program. They were only a small fraction of the overall south Atlantic Japanese effort. The Japanese were the only country participating in the Brazilian leasing program until the 1990s. The extensive Brazilian Atlantic operations, expertise with the gear and methods, and contacts facilitated by ethnic Japanese working in the fishing industry help explain Japan's domination of the leasing program. Japanese fishermen reported significant annual fluctuations in their effort deployed under the leasing program. Since the entry of the other foreign fishermen in the 1990s, Japanese fishermen have substantially scaled back their effort.

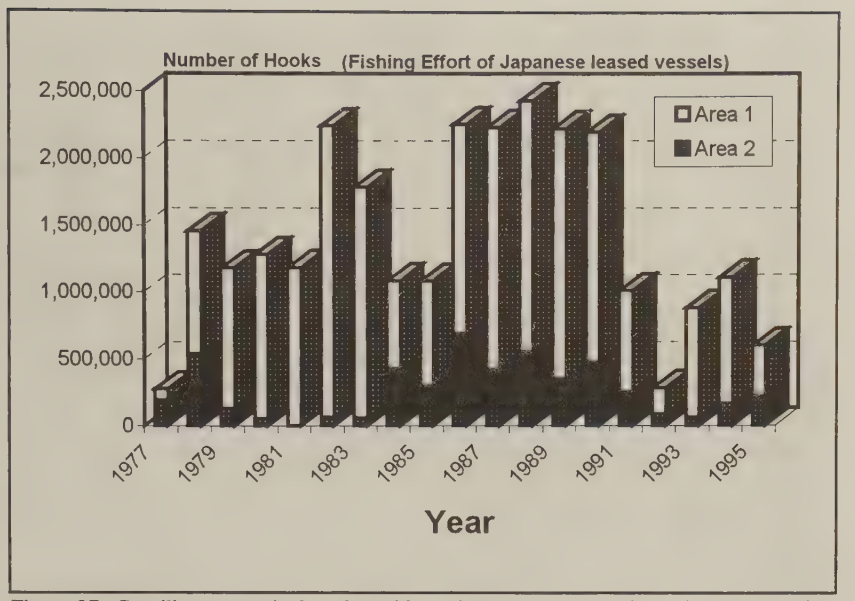


Figure 97.--Brazilian companies have leased fewer Japanese vessels and thus the Japanese effort off Brazil has declined since 1990.

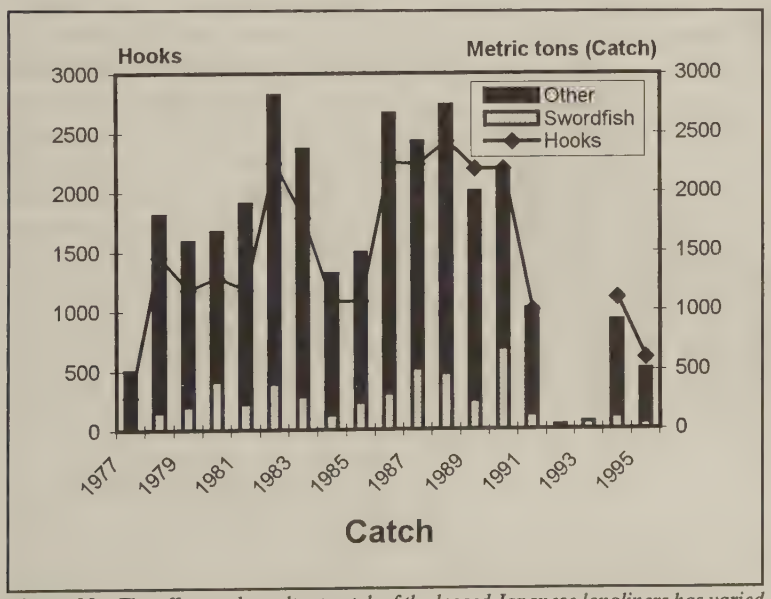


Figure 98.--The effort and resultant catch of the leased Japanese longliners has varied substantially from year to year.

Korea: Korea publishes details on the longline tuna fishery. While no data is available specifically on swordfish, the

overall Korean Atlantic longline fishing pattern is of interest. Korean longliners operated on the Guianas Banks during 1988 and 1989, including areas off Suriname. The Koreans fished as far west as 60°W, including the entire coast and offshore areas off Suriname. Korean longliners shifted operations in 1990 more to the east, only venturing as far west as 50°W, which is off Brazil but east of all three of the Guianas. This shift to the east continued in 1991 and 1992, the latest year for which data is available. Korean Atlantic tuna operations in 1988-92 were all reported in tropical waters between the Guianas/Brazil and West Africa. The fishery in 1988 ranged from 15°N to 10°S, but in later years minor operations as far as 20°S were reported. Overall operations declined significantly in 1991 and 1992. Except in 1989, the Korean fishermen have generally not approached the Brazilian coast, presumably because of Brazil's enforcement of its 200-mile zone.[749]

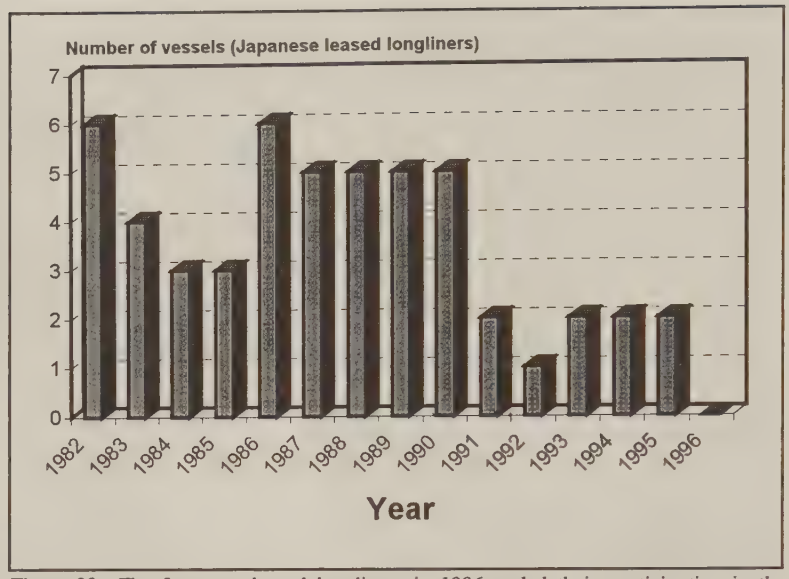


Figure 99.--The Japanese leased longliners in 1996 ended their participation in the Brazilian licensing program.

Portugal: Portuguese operations are limited, but since 1995 they have reported distant-water catches of about 400 t (appendix E3a1). The authors observed one of the Portuguese longliners, the *Rio Pravia,* landing fresh fish at Natal during 1998. Unconfirmed reports suggest Spanish involvement in the Portuguese longliners.

Spain: Spanish longline fishermen have generally operated off Brazil and Uruguay, but outside the 200-mile limit.[750] Spanish longline operations initially focused more on the African coast (5°N-35°S) than along the Brazilian coast (figure 9). The Spanish subsequently operated seasonally off South America (5°N-35°S) (appendix A2c5).[751] Spanish operations off Brazil appear to have initially focused on the southern coast (figure 10). More recent leasing operations out of Cabedelo have expanded Spanish operations off northeastern Brazil. More than 50 Spanish longliners and combination vessels (doing at least some longlining) are deployed in the south Atlantic (appendices E1a and E2a), and several report operations off Brazil outside of the 200-mile limit (appendix A2c5). Spanish catch data shows substantial areas of fishing outside Brazil's 200-mile EEZ (figure 9 and 10). There are no large companies deploying vessels, but almost all of the tuna longliners are owned by companies with only one or two vessels.[752] The fishermen do report a sense of camaraderie when they encounter each other at sea and often share food and fuel when needed.[753] One fisherman who operates off Africa (transshipping in Namibia) and off Brazil and Uruguay (transshipping in Montevideo) reported in mid-1996 that he last operated off Brazil and Uruguay in 1994.[754] Fishermen have reported a desire to fish in Brazilian waters, but have had difficulty obtaining Brazilian permits.[755] Unlike

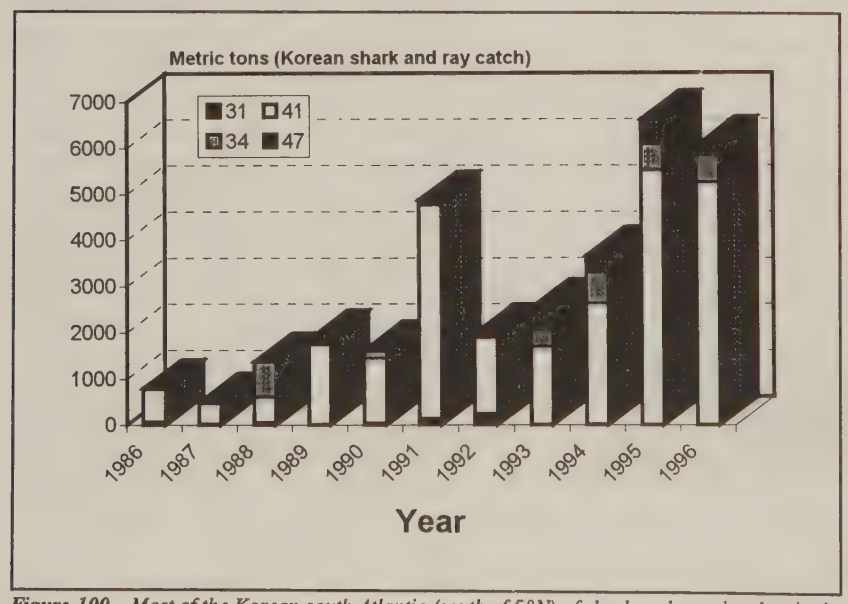


Figure 100.--Most of the Korean south Atlantic (south of 5°N) of shark and rays is taken in the southwestern Atlantic (FAO area 41).

several other countries, few Spanish companies have negotiated leasing arrangements with Brazilian companies (appendix A1c). One Spanish longliner negotiated a leasing contract in 1993. It is unclear why the Spanish have been generally reluctant to lease their vessels. One Spanish fisherman indicated that south Atlantic catches were very poor in 1996. The Spanish primarily focus on swordfish, which generally is more than 60 percent of their south Atlantic catches. Much of the remaining catch retained is tuna and mako sharks ("marrajo"), but they also retain limited quantities of other sharks.[756] Spanish fishermen have since 1996 negotiated leasing arrangements to deploy a few longlines off northern Brazil. Two contracts were signed in 1996 and larger numbers are reported in 1997 and 1998. The fishermen operate out of Cabedelo near João Pessoa. Brazilian sources indicate in 1998 that six Spanish longliners were working under contract with Cabedelo de Pesca.[757]

Photo 208.--Taiwan fisheries in recent years have reportedly shifted their focus from swordfish to albacore tuna. Dennis Weidner

Taiwan: Several Taiwan companies operate longliners out of Montevideo.[758] Most operate outside the 200-mile limit from northern Brazil south to Uruguay. A substantial number of vessels during 1991-94 obtained access to Brazilian waters by leasing their vessels to Brazilian companies. (See: "Joint ventures.") Leasing activity declined in 1995 and the Taiwan fishermen appear to have shifted operations to albacore on the highseas. Most of Taiwan's Atlantic longline operations are on the highseas, outside the coastal 200-mile zones. The Taiwan swordfish catch is limited, but the catch composition varies seasonally. One source suggests the vessels operate off northern Brazil from October to March and land relatively substantial quantities of swordfish and marlin. After March the Taiwan fishermen move to more southerly grounds off Uruguay and the proportion of albacore increases. A normal catch for one trip off Uruguay might include: albacore (230 t), swordfish (5 t), shark (10 t), bigeye (7 t), and marlin (2 t). The marlin catch would normally be higher in the northern grounds off northern Brazil.[759] The authors do not have access to extensive annual data on Taiwan operations. Information available for 1992 shows longlining all along the Brazilian coast and offshore waters, but the location of actual catches varied greatly.[760] Billfish catches, which included swordfish, were reported during

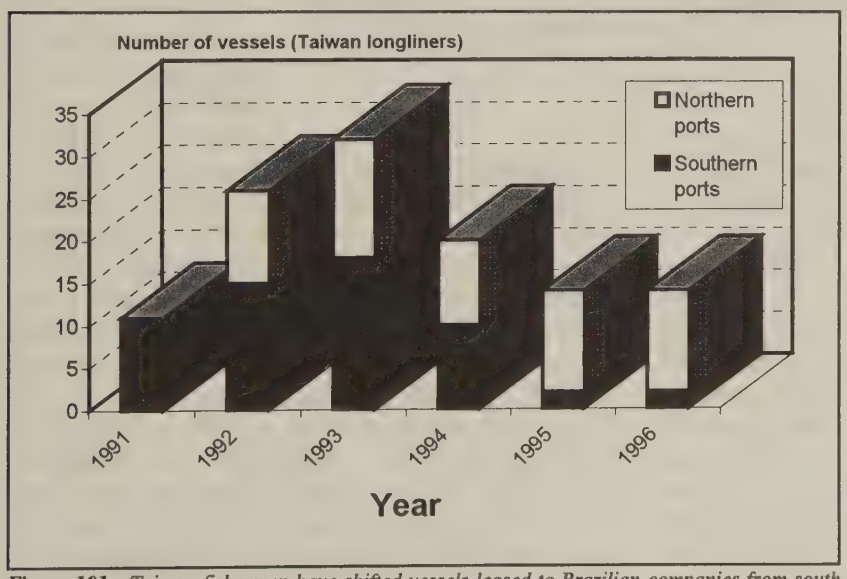


Figure 101.--Taiwan fishermen have shifted vessels leased to Brazilian companies from south to northern ports.

1992 in:

North: Catches were reported off the northeastern coast in January, but further offshore in February and March. Very good catches were reported in April, but then declined for the rest of the year.

Central: Good catches were reported off central Brazil in January and February, but moved further south in March. Some good catches were reported in offshore areas off the central coast, but catches then declined until September. Some fishing was also reported in October and November but with limited results.

South: No catches were reported in January and February, but good results began in March. Some fishing was reported from April to June, but good results were not achieved until July, but lasted through October after which limited results were reported in offshore areas.[761]

Photo 209.--Japanese fishermen were the primary foreign country operating longlines in Brazil, however, Taiwan fishermen have been especially active off Brazil during the 1990s. Dennis Weidner

Overall Taiwan operations in 1992 focused more on the western south Atlantic off Brazil and the rest of Latin America than on the eastern south Atlantic off Africa.[762] Taiwan longline fishermen report growing problems with killer whales, especially when targeting swordfish off Brazil, possibly because the hooks are set in relatively shallow water.[763] Press reports indicate that the Taiwan Council of Agriculture (TCOA) agreed to reduce its albacore operations in 1998 as part of overall ICCAT efforts to reduce fishing effort on the species. The TCOA indicated that Taiwan will reduce the albacore tuna by 2,649 t to 16,140 tons. Taiwan fishermen take the bulk of the albacore caught in the south Atlantic.[764] No mention was made of swordfish. Taiwan fishermen, like the Spanish, are acting out of Cabedelo in association with Cabedelo de Pesca. One report indicates that six Taiwan longliners were acting out of Cabedelo in 1998.[765] No details are available as to what the Taiwan fishermen are targeting. One local Cabedelo source indicated swordfish, but the authors were unable to confirm this.

USSR: Soviet vessels reported small catches in the early 1990s. Since the breakup of the Soviet Union, the fleets of the resulting countries have reported south Atlantic catches. Lithuania reported a catch of almost 800 t of swordfish in 1994.

United States: The authors through 1994 know of no U.S. longliners operating off Brazil, although there may have been some U.S. participation in the small number of flag-of-convenience vessels leased during the 1990s. A few U.S. fishermen have worked with several Brazilian companies in Santos during the 1990s to help them conduct trials of U.S. monofilament gear. The Brazilians have been generally impressed and a substantial number of companies have re-rigged their vessels and have begun to adopt U.S. methods which emphasize targeting swordfish rather than conducting Japanese-style multiple-species operations that were previously common. U.S. fishermen have also worked with Norte Pesca out of Natal.[766] One NMFS observer in 1996 spoke with Brazilian scientists who claimed that several U.S. longliners were operating in Brazilian waters and landing their catch in Brazilian ports.[767] The authors have been unable to confirm such U.S. activity, with the exception of one U.S. longliner, the *Pocahontas*. Some U.S. fishermen work with flag-of-convenience vessels. The logbooks submitted by U.S. fishermen have reported activity along the Guianas Banks, outside the 200-mile limit, for several years. Limited U.S.

fishing in 1994 was reported off Guyana and Suriname. Fishing activity expanded significantly in 1995, in areas east of the Antilles (primarily east of 55°E) and off the Surinamese and to a lesser extent the French Guianese coasts, but included some very limited activity off Brazil. The bulk of the U.S. activity was at some distance north of the Brazilian coast (primarily from 10°-20°N). U.S. fishing along northeastern South America, outside the 200-mile limit, was less concentrated in 1995, extending all along the Guianas Bank, but extending into new areas off the Brazilian coast for the first time. The fishing grounds off Brazil were at a considerable distance from the coast (primarily from about 42-32°E), although some fishing was reported closer to the coast in offshore waters adjacent to French Guiana.[768] U.S. fishing in 1996 continued to expand to the west and south. U.S. companies for the first time signed association contracts with Brazilian companies, permitting operations with the 200-mile EEZ (appendix E3b3a1). U.S. fishing was reported as far south as the equator (0°) and as far east as 33°E.[769] A small number of U.S. vessels are known to have operated in the south Atlantic without reporting their catch to NMFS. Until 1997 U.S. regulations did not require fishermen operating south of 5°N to report catches, but new regulations now require reporting.

Photo 210.--The "Cape Horn" in 1998 was operated out of Natal where longline activity has expanded in the late 1990s. Dennis Weidner

Venezuela: Venezuelan officials discussed possible access to Brazilian tuna grounds in 1991. The Venezuelans agreed to land up to 50 percent of their catch in Brazil, but would be paid at international prices. Brazil offered a variety of credits.[770] Few additional details are available, but the authors believe that the discussions referred to the Venezuelan seiner fleet and not to longliners.

2. Multilateral

Brazil has had few government-to-government contacts on issues involving highly migratory species like tuna and tuna-like species. The primary contacts with other governments on the issue of swordfish and other highly migratory species in general has been through ICCAT.

ICCAT: Brazil is a member of the International Commission for the Conservation of Atlantic Tunas (ICCAT). In the past, the ICCAT species of primary interest to Brazil have been tunas although Brazil does have a history of harvesting various billfish species as well as swordfish. ICCAT has promoted a variety of research projects and has instituted management measures for both swordfish and billfishes. Regarding the management of swordfish, the emphasis has been on the north Atlantic stock; however, concern about the south Atlantic stock has been increasing. Brazil participates in several ICCAT sub-bodies, including Panel 4. This panel is responsible for developing conservation and management measures for swordfish and billfishes, among other species.[771] Budget constraints and the relatively minor importance of the south Atlantic swordfish fishery to Brazil limited Brazil's participation in ICCAT regulatory measures and other programs during the 1980s and early 1990s. In recent years, Brazilian officials have given more attention to ICCAT. Brazilian involvement appeared to increase after ICCAT began considering quota management for south Atlantic swordfish. Brazil in 1997 hosted an intercessional ICCAT meeting to address specifically quota allocation issues related to this stock. While agreement on harvest levels and a sharing arrangement was reached, Brazilian officials have sharply criticized the current ICCAT quota sharing regime. Brazil along with Uruguay and South africa expressed their dissatisfaction with the allocation scheme by formally objecting to an ICCAT measure

designed to encourage compliance with the scheme. (See "Government Agencies and Policies" for more information on this issue.) Developing coastal states, such as Brazil, have also expressed concerns about ICCAT quota allocation practices in general. At the 1998 ICCAT meeting, Brazil helped spearhead the formation of a working group to analyze and consider recommending criteria to be used by ICCAT in determining future quota allocations. This working group is to meet prior to the Brazil-hosted ICCAT annual meeting in April 1999. In addition to quotas, ICCAT has in place minimum size measures that apply to swordfish throughout the Atlantic. Brazilian officials, like those in other countries in the region, were initially hesitant to implement a minimum size, contending that such a measure was unnecessary. (appendix E5).[772] Officials in Brazil have since decided that intensive fishing pressure and declining fish sizes did justify the use of minimum size as a conservation and management tool. Officials have instituted the ICCAT minimum-size regime.[773] The authors note, however, that despite the minimum-size regulations that there appears to be substantial quantities of under-sized swordfish available in Brazilian markets.[774]

Brazil participated in the negotiations of the international convention on straddling fish stocks and highly migratory species conducted during 1994 and 1995. A convention was finally adopted by a U.N. conference on August 4, 1995. Brazil signed the treaty on December 4, 1995.

B. Joint ventures

Foreign companies have played an important role in the Brazilian tuna and tuna-like fisheries for species like swordfish and billfish. There has been limited foreign equity investment in traditional joint venture relations, which usually means equity participation by the foreign partner. Rather, Brazilian companies have involved foreign companies through contractual leasing relationships. These contractual relationships have helped Brazilian researchers compile a detailed data base (species, seasonality, and grounds) on swordfish, tunas, and other species taken in the longline fishery. Researchers have also compiled important oceanographic data detailing the relationship between temperature and fish abundance. The leased operations have provided some employment opportunities and have helped introduce valuable improvements in fishing gear and methods.[775]

Some details on the contractual nature of the individual contracts are available. Several of the participating companies (Imaipesca, Leal Santos, and Pescal) have reviewed their recent contracts with the authors and they appear to all be quite similar, although not identical. Norte Pesca has also indicated that these leasing contracts are similar to the arrangements with other Brazilian companies.[776] Primarily the contract calls for the contracting company to pay all the local costs (supplies, water, port costs, Brazilian crews, etc.) except fuel. The foreign company providing the longliner pays for the fuel, foreign salaries (captain, engineer, and some crew members). The Brazilian company then receives a guaranteed 10 percent of the profits (sales minus costs) and the foreign company receives the balance.[777] Some of the principal differences between contracts is that often the Brazilian company must put up their contribution in advance, or an amount to cover their liability if the leased vessel has a poor catch which does not cover costs. The foreign companies agree to hire local crew members, generally about 40 percent of the crew. This proved somewhat difficult, especially in the southern port of Rio Grande. Many of the fishermen working on the domestic and leased vessels are from tropical/semi-tropical northeastern Brazil. Many were reportedly reluctant to move to southern Brazil, in part because of the cooler weather. Others reportedly had problems adjusting to living conditions on the leased vessels.[778] As a result, the crews on the leased vessels, especially the non-Asian vessels leased out of Rio Grande, often come from a wide variety of different countries. The crews on the Asian longliners (Japan, Korea and Taiwan) are more likely to be nationals from those countries.[779]

The first longliners targeting highly migratory species (tunas, swordfish, and billfish) were leased from the Japanese in 1977 and through 1991 most of the leased vessels were Japanese. Brazilian companies shifted to Taiwan companies in 1991 and have since dealt with companies in Taiwan and several other countries rather than exclusively with fishermen from one country.

Photo 211.--The "Yung Hai" and "Yung Yang" longliners operated by China Sea Products docked at Montevideo. The vessels were active in the Brazilian leasing program. Dennis Weidner

Barbados: The Fins & Fathoms company of Barbados conducts large-scale commercial longline operations. This company is reportedly the only Caribbean company operating longliners over 20 meters. The company's owners realized during the early 1990s that the only way to expand fishing operations was to shift away from production solely of heavily fished species (flying fish, dorado,

and others) for the domestic market and to enter fisheries for oceanic pelagics not targeted by the artisanal fishermen. Such species had the advantage of commanding high prices in major export markets. One of the owners, Jonathan Morgan, indicated, "Both of us felt that, if the Japanese could successfully longline tuna out of St. Maarten and the Taiwanese can do it out of Trinidad, then a Barbados-owned and operated company could be successful." The company, using a U.S. broker, acquired two vessels in 1992 (the 27-m *Colleen Cheramie* and the 24-m *King of Kings*) and had them refitted for longline operations. U.S. masters were contracted to operate the vessels as no Barbadians had experience with operating a large longliner. The rest of the crew was all Barbadian. The vessels are deployed in the central Atlantic, primarily for tuna (yellowfin and bigeye). The company had planned to ship 15-20 t of tuna annually once its two longliners were fully operational. The bycatch was to be sold on the domestic market.[780] Fishing operations out of Barbados, however, proved disappointing. The company decided in late 1995 to lease the two longliners to Brazilian companies for operations off Brazil and has since been working there. Both vessels in mid-1998 were working with Norte Pesca out of Natal.[781]

China: Some Brazilian authors refer to longline vessels leased from China. These vessels are actually Taiwan vessels (appendices A2c3 and A2c4). The authors know of no actual Chinese vessels deployed in the fishery.

Honduras: One 1995 report indicated that Brazil issued swordfish licenses to Honduran-flagged longliners operated by U.S. owners.[782] Brazilian sources report that local companies (Kawai) leased two Honduran-flag vessels (*Atlantic Core* and *Sea Wolf*) since 1992 (appendix A2c3). Both reportedly have U.S. owners. Foreign owners of fishing vessels routinely obtain flag-of-convenience registrations in Honduras.[783]

Japan: Japanese companies have played an important role in helping to initiate the Brazilian longline fishery for tunas and swordfish. Brazilian businessmen visited Japan in 1975 to discuss possible joint ventures or vessel leasing arrangements. The meetings led to several actual commercial arrangements.[784] A Brazilian company located in Rio Grande began the fishery by leasing three Japanese vessels in 1977. Other companies leased a few other Japanese vessels. A total of six vessels, for example, were leased in 1982 (appendix A1c). The vessels were often deployed off southern Brazil (27°30'-33°44'S), usually from May to December. The Rio Grande company expanded the operation to five leased vessels in 1985 and continued to use Japanese vessels until 1991. The Rio Grande company shifted to Taiwan vessels in 1991.[785] The total number of leased Japanese longliners declined to 2 in 1991 and 1 in 1992 (appendix A1c). Japanese distant-water fishermen in 1993 did not report tuna and billfish or swordfish fishing off Brazil.[786] The Japanese have not been very active in the south Atlantic, but rather have concentrated operations at equatorial latitudes in the mid-Atlantic beyond Brazil's 200-mile zone and along the African coast.[787]

Korea: Brazilian businessmen visited Korea in 1975 to discuss possible joint ventures or vessel leasing arrangements. The meetings, however, did not lead to any actual commercial arrangements.[788] A few Korean longliners were reportedly briefly deployed off Brazil during the mid-1970s, but few details are available. Korean longliners were not redeployed in Brazilian

Photo 212.--The "Julius" pictured here in Natal is a Honduras-flag, leased longliner that has been active off Brazil since 1996. Dennis Weidner

Photo 213.--Foreign-leased vessels like these Honduran and Portuguese-flag vessels were active off the northeast out of Natal in 1998. Dennis Weidner

waters until 1994 when two longliners were leased by Real Santos in Rio Grande do Sul (appendices A1c and A2c3).

Panama: The first Panamanian-flagged longliner was deployed off Brazil in 1992. Foreign owners of fishing vessels routinely obtain flag-of-convenience (foc) registrations in Panama.[789] The Panamanian flag *Jer Dos* which operated out of Santos in 1993-94, for example, was reportedly owned by a Spanish company. The *Julius* which arrived in 1996 reportedly has multiple owners, including a U.S. partner. Both of the Panamanian vessels were leased by Kawai (appendix A2c3). The *Julius* now works out of Natal in association with Norte Pesca.[790]

Portugal: Portuguese longliners have been operating off the northeast out of Cabedelo since 1993. As of August 1998, two Portuguese longliners were active. Unconfirmed reports indicated the vessels were operating with monofilament grass.[791]

Spain: Spanish fishermen have significantly increased fishing effort in the south Atlantic during recent years (appendix E3a1). The Spanish began to report substantial catches in both the southwestern and southeastern Atlantic in 1989 (Brazil, appendices E3a1-2 and Latin America, appendix C2b). The initial Spanish effort off Latin America during 1989-90 appears to have been directed at tropical waters off northeastern Brazil (5°N-5°S and east of 40°W) in conjunction with their larger fishery off Africa in the Gulf of Guinea.[792] Spanish fishing in 1993 continued in the south Atlantic off northern (5°N-5°S) and southern (25°-35°S) Brazil, but beyond the 200-mile

Photo 214.--Foreign longliners like the "Julius" are often registered in countries like Honduras that make foc registrations, but these registrations can change frequently. Dennis Weidner

zone.[793] The Spanish also fish out of Montevideo and a joint venture has been formed with a Uruguayan company.[794] Spanish fishermen have occasionally called at Brazilian ports, but until recently, did not have permission to fish in the to Brazilian EEZ--especially the waters off southern Brazil where high catch rates have been reported.[795] Unconfirmed reports indicate that Spanish fishermen in 1994 or 1995 have negotiated leasing agreements with Brazilian companies that would give them access to Brazilian coastal waters.[796] Brazilian Naval authorities and company representatives, however, reported that no Spanish vessels were being leased for operations off southern Brazil. Spanish interests in 1994 are also known to have provided at least one of the leased boats with flag-of-convenience flags, the *Jer Dos* (appendix A2c3). The character of Spanish operations off Brazil began to change in 1996 when leasing arrangements were negotiated with a small company in Cabedelo (Paraíba). The Cabedelo de Pesca company in Cabedelo during 1996 reportedly leased two Spanish longliners (*Cosmos* and an unknown vessel) for operations off the northeast coast.[797] Cabedelo is a cargo port along the northeast coast north of Recife. While operations out of Cabedelo suggest that the Spanish operated along the northeast coast they were not confined to this area. Their vessels were capable of extended voyages. The Spanish longliners are freezer vessels and thus can remain on the fishing grounds for extended trips. The authors, however, only know of landings at Cabedelo. Spanish operations had expanded to six longliners by 1998.[798] The vessels continue to operate out of the cargo port at Cabedelo and the swordfish catch is shipped frozen to the European Union (primarily Spain). The rest of the catch is marketed locally by Cabedelo Pesca. Little information is available on the Spanish operations. Cabedelo has only a small artisanal fishing port. The Spanish longliners use the cargo port. Brazilian longliners do not operate out of Cabedelo. Thus the Spanish have little contact with Brazilian fishermen.

Taiwan: A Brazilian company reportedly leased 11 Taiwan longliners in 1991 to fish for swordfish and tuna off southern Brazil.[799] It is unclear why after so many years of relying upon the Japanese that the Brazilian companies turned to the Taiwan companies in 1991. One Brazilian company representative indicated to the authors that the decision was not a matter of Brazilian companies choosing the Taiwan fishermen over the Japanese fishermen. He suggested that the Taiwan companies simply decided to pursue opportunities in Brazil for the first time in 1991. Other Brazilian sources suggested that political decisions made the entry of the Taiwan vessels possible, but no details are available. Several Taiwan companies are involved.[800]

Photo 215.--The leased longliner "Olympic Champion" has been active throughout the south Atlantic during the 1990s, off both Uruguay and Brazil. Dennis Weidner

China Sea: This company was established in the late 1970s. It operates about six longliners in the south Atlantic (Uruguay, appendix A2c4) and leased six of those longliners to the Leal Santos company in Rio Grande at various times during 1991-94 (appendix A2c3). Initially China Sea targeted swordfish, but because of disappointing results shifted to albacore.[801]

Other: Several other Taiwan companies are involved, but the authors have been unable to obtain data.

The number of leased Taiwan longliners increased to 15 in 1992 (appendix A1c) Almost all of the Taiwan

fishermen, however, withdrew from Brazil after 1994. Taiwan sources indicate that the fishing companies were disappointed with the catches (they primarily targeted swordfish) that they were able to harvest within Brazilian waters. Most of the companies have continued operating in the south Atlantic, but theoretically outside Brazilian waters.[802] (See: "Bilateral" above.) Some Brazilian sources believe there may be some Taiwan fishing within 200-miles, but the absence of any seizures suggests that any such activity may be limited in scope. (See: "Enforcement.") One report from Cabedelo indicated that the Taiwan fishermen in 1998 had shifted to monofilament gear and begun to target swordfish.[803] The authors have, however, been unable to confirm this report.

United States: U.S. longline fishermen expanded operations into the Caribbean during the mid-1980s. A few fishermen have reportedly fished off the Guianas and northern Brazil outside of the 200-mile EEZ.[804] It is rare, however, for U.S. fishermen to venture further south.[805] U.S. longliner fishermen report difficulty obtaining Brazilian fishing licenses.[806] Some U.S. swordfish operations have been reported as far east as the coast of Africa (Cape Verde) and as far south as Uruguay, but such trips are highly unusual.[807] U.S. fishermen in recent years (1992-1994) have reported some activity off the Guianas, but no effort off of Brazil. The most southerly U.S. effort was about 7°N.[808] Brazil's northerly border is about 3.5°N. U.S. vessel owners, however, have participated in leasing arrangements for at least some of the vessels with flag-of-convenience (Honduras and Panama) flags (appendix A2c3). There is also one U.S. vessel (*Seneca*) fishing in association with the Norte Pesca company in Recife.[809] U.S. vessel owners, with a few exceptions, have been reluctant to conclude leasing arrangements with Brazilian companies.

Photo 216.--Foreign fishermen, gear, and methods have played a key role in the Brazilian longline fishery. The gear and equipment used by these fishermen on the "Icaema XXIII" was imported.

Venezuela: Venezuelan business representatives visited Brazil in 1988 to discuss possible joint ventures to fish for tuna and shark off northeastern Brazil. Swordfish catches would presumably also be involved. Venezuelan fishermen were interested in access and the Brazilians were interested in establishing a tuna processing industry in a northeastern port.[810] The authors know, however, of no actual agreement resulting form these discussions.

Photo 217.--The foreign-owned "Julius" was tied up inactive at Santos during August 1996. The vessel was awaiting the arrival of needed parts. Dennis Weidner

Various Brazilian companies have been active in leasing foreign vessels for tuna and swordfish fisheries. These companies have negotiated simple licensing agreements without foreign equity participation. Other companies have expressed an interest in more comprehensive associations. One company (Linker Empresarial e Institucional) in 1992 expressed an interest in possible ventures out of Ceará.[811]

C. Foreign aid

Foreign fishermen have played a key role in developing the Brazilian pelagic longline fishery. For the most part, however, it has been primarily commercial contacts between companies or individuals in Japan, Korea, and the United States, rather than a coordinated Government plan. Fisheries foreign aid has been primarily targeted on Brazil's large, but essentially primitive artisanal fishery.

1. Multilateral

The authors know of no multilateral agency currently promoting the longline fishery. The Inter-American Development Bank approved a small $1.75 million grant in January 1988, but it dealt with coastal zone planning and artisanal fishing in Pernambuco and Pariíba states.[812]

2. Bilateral

Fishermen and companies from several countries have provided technical assistance on a commercial basis. These contacts have played a key role in developing Brazil's longline fishery, but have primarily been commercial arrangements resulting for the operations of foreign fishermen. Government foreign aid programs, however, have played a minimal role in the development of the longliners.

Canada: Canada has sponsored a few small fishery projects in Brazil, mostly during the 1980s through the Canadian International Development Agency (CIDA). The projects concerned seafood processing, inspection, fisheries research and other matters.[813] None of the projects touched upon the longline fishery. The Superintendent of SUDEPE, Roberto Amaral, visited Canada in 1982, in part to help Brazil upgrade its longline fleet.[814]

China: Brazil and China signed a scientific and technical cooperation agreement in 1982. Aquaculture was mentioned as an area of cooperation, but not capture fisheries.[815]

Japan: Japan has sponsored a few small projects in Brazil, including the establishment of a small fisheries complex during the 1970s.[816] None of the projects were associated with the longline fishery. In fact a consortium of Japanese experts working with British and Brazilian specialists (ADIPLAN) concluded during a 1973/74 assessment that Brazil should focus on

aquaculture and that resources off the northeastern coast were limited.[817] Brazilian authorities in 1979 requested assistance from Japan to find alternatives for the Copesbra whaling facilities at Cabedelo and press reports indicate that the subject was still under consideration in 1982.[818]

Korea: Korea has provided some assistance on shrimp culture during the 1980s.[819] Press reports suggested possible agreement on joint shrimp fishing ventures in 1981.[820]

Spain: The authors know of no Spanish fisheries assistance to Brazil. While the Spanish conduct a major swordfish fishery in the south Atlantic, there fishermen were not active in the leasing program until 1996. Even now that they are active, they operate from such a isolated port (Cabedelo) that they have very limited contacts with Brazilian fishermen. Thus technology transfer through the leasing arrangements have been very limited.

Taiwan: The authors know of no Taiwan fisheries assistance to Brazil. Brazilian recognition of mainland China means that Taiwan assistance is unlikely. The involvement of large numbers of Taiwan vessels off Brazil has provided for some technology transfer although language barriers and varying attitudes of the Taiwan captains have limited this.

United Kingdom: UK officials reported only a small oyster culture project in 1977.[821]

United States: The United states in recent years has provided no foreign assistance in capture fisheries, other than technical assistance for the turtle excluder devices (TEDs) being installed in shrimp trawls. The U.S. Agency for International Development has financed aquaculture projects through Auburn University's International Center for Aquaculture.[822]

Multilateral donors have also assisted with Brazilian fisheries, although activity has been limited during the 1990s:

Food and Agriculture Organization: The FAO in 1967 initiated a 10-year program to promote fisheries research. One of the main focuses was aquaculture rather than marine fisheries.[823] FAO assisted a marketing scheme in the northeast to help artisanal fishermen market their catch.[824] FAO has sponsored fisheries resource assessment cruises off Brazil.[825] It prepared several assessments of Brazilian fisheries, including one Western Central Atlantic Fisheries Development Project (WECAF) study on artisanal fisheries in the northeast.[826] FAO in the late 1980s and 1990s has helped an aquaculture research station as part of its Regional Aquaculture Activities for Latin America and the Caribbean (AQUILA).[827]

Inter-American Development Bank: IDB provided $66 million in loan guarantees for a $130 million fishery development program in the 1980s. The project included: acquiring about 160 commercial vessels (shrimp trawlers in north and various vessels in the south), acquiring artisanal boats for cooperatives and villages, building a fishing port (Porto Grande), purchasing research vessels, and build aquaculture centers. The Centro de Pesqueira da Região Sudeste-Sul (CEPSUL) was financed by the project. The program was aimed at supporting the country's Third National Development Plan.[828] The IDB's subsequent role in fisheries has been much more modest. The IDB, for example, provided $0.5 million in credits during 1989 from a Swiss fund for artisanal fishermen on Rio Grande do Norte.[829] IDB also approved a $1 million project in 1992 to assist artisanal fishermen.[830]

World Bank: The World Bank participated in the IDB fisheries development program during the 1980s.[831]

XVII. Enforcement

Fishery regulations at sea are enforced by the Brazilian Navy. IBAMA or the new Departamento de Pesca (DP-Ministry of Agriculture) offices in a few ports have small boats, but they are not widely used. Virtually all the at-sea enforcement is conducted by the Navy. IBAMA/DP's enforcement role is almost entirely shore-based.[832] The Navy is not, however, well-equipped for fisheries enforcement. It has only a few small coastal patrol boats. The Navy's vessels are large and expensive to operate. As a result, fisheries enforcement patrols are limited. This is in sharp contrast to neighboring Uruguay, where the Government has devoted more attention to fishery patrol functions and has regularly seized Brazilian fishing boats which attempt to fish in Uruguayan waters.[833] The Brazilian Government, unlike other major Latin American coastal countries (such as Argentina, Chile, and Peru), as of 1998 was not implementing a satellite tracking system to monitor fishing vessels. This probably reflects, in part, the smaller role that the fishing industry plays in the country's economy. Severe budget constraints as a result of the 1999 decline of the real make the adoption of such a system unlikely for the foreseeable future. A satellite system would have to be contracted from foreign suppliers and the cost in reales has doubled as of February 1999.

Brazilian officials are concerned about foreign longlining off their coast, especially off the northeastern coast. Extensive foreign longline operations are conducted by Japanese, Spanish, and other countries at equatorial latitudes between Brazil and Africa. Some of these vessels have even attempted to call at Brazilian ports. Naval officials believe some of the foreign fishermen are operating illegally in the Brazilian EEZ. Brazil does not formally license foreign fishing vessels. The Government does, however, allow Brazilian companies to lease foreign fishing vessels. (See: "International Relations.") Government officials believe that foreign fishermen take advantage of regulations allowing foreign vessels to make emergency calls. This problem appears to be especially severe in northeastern Brazil.[834] One unconfirmed report suggests that during the late 1980s, foreign fishing vessels made 140 emergency port calls during 1 year at Recife alone.[835] Such calls were also reported at Cabedelo, Fortaleza, Natal, and other northeastern ports. The total number of emergencies reported in that year totaled 160-200 foreign vessels.[836] Given that many of the vessels are large commercial longliners, the effort involved is

Photo 218.--The Brazilian Navy reports seizing a substantial number of small Uruguayan vessels, but they have also seized a few large distant-water fishing vessels. Dennis Weidner

Photo 219.--This Brazilian patrol boat was tied up at Santos. The Navy has an enormous EEZ to patrol with only limited resources. Dennis Weidner

considerable. Fishermen from several countries (primarily Korea, Japan, Spain, and Taiwan) were involved. The fishermen while in port were allowed to purchase fuel and supplies and land some of their catch. Some local officials (especially in the state of Pernambuco), because of the income generated, reportedly resisted Navy efforts to limit these port calls. The problem appears to have moderated somewhat during the 1990s. This is in part because several foreign vessels now operate legally from the Pernambuco port of Cabedelo. Naval officials also appear to have become stricter in evaluating emergency requests, but it is not known if any new regulations were issued. Naval officials report, however, that an unusually high number of foreign vessels still continue to claim emergencies to enter northeastern ports.[837]

Brazilian officials have expressed some interest in cooperating with African officials to control foreign fishing. Several distant-water operations, for example, are conducted in a band of tropical waters (5°N-5°S) stretching from the Gulf of Guinea off Africa to the coast of northeastern Brazil. (See: "Japan" and "Spain" above.) The fishing off Africa appears to be much more intensive than off Brazil. Apparently Brazilian officials believe that cooperation with African officials could better control foreign distant-water operations and improve fishery patrols. Brazilian officials in September 1995, participated in a conference with Portuguese-speaking African countries and Portugal.[838]

XVIII. Future Trends

The tuna/swordfish longline fishery has been a relatively minor fishery in Brazil. The fishing fleet involved relatively few vessels and crews and there was virtually no value-added processing. The overall effort and financial return was small in comparison to the country's much more significant fisheries for lobster, shrimp, sardines, tuna (for canning), and other species. The domestic swordfish catch totaled only 300-800 t in most years from 1975-93.

Brazilian domestic longline fishermen have substantially increased swordfish catches in recent years. Brazil conducts the largest Latin American Atlantic-coast swordfish fishery. The Brazilian swordfish catch in 1994 and 1996 was at or above the 1,000 t level. Preliminary reports suggest that the 1997 catch exceeded 2,000 t and the 1998 catch may be slightly higher. Further catch increases are possible. Significant catch increases could be anticipated, for example, if currently low swordfish prices were to recover.

The expansion of the Brazilian catch appears to be due to several factors:

Fleet expansion: Brazil's longline fleet has been expanding, although there are significant annual fluctuations. The authors, however, do not have sufficiently detailed information to fully assess the fleet's expansion. ICCAT reports a fleet of 23 domestic longliners in 1996, an all-time record.

Fleet improvements: Vessel operators have been upgrading existing vessels and adding improved, more modern vessels to the fleet. Many Brazilian companies deploy older vessels designed for other fisheries, re-rigged for longlining. Some of the vessels were not well-suited for this conversion and there are, as a result, great variations in the existing Brazilian fleet. Some companies are now acquiring new, purpose-built longliners. There is a debate in industry circles, however, as to whether the substantially higher costs of acquiring modern, purpose-built vessels are justified by their superior performance.

Gear conversion: Perhaps an even more important factor has been changes since the mid-1990s in fishing gear and methods. Brazilian fishermen have generally shifted from the old Japanese-style multi-species fishery using braided line, to the U.S.-style monofilament line using light sticks and targeting swordfish. This conversion began in 1994 and most of the fleet has since been converted.

Artisanal fishermen: The catch increases reported in 1997 have been achieved by commercial fishermen. Brazilian researchers and companies working with artisanal fishermen have developed fishing strategies allowing them for the first time to participate significantly in the pelagic longline fishery. Artisanal fishermen have, in many locations, depleted many resources and inshore grounds are heavily fished. Many artisanal fishermen are interested in the prospects of this new fishery. Preliminary results are encouraging. Given the size of the artisanal fishery and the relatively modest cost of purchasing and rigging a small boat, a successful artisanal fishery could potentially mean a future significant expansion of the Brazilian swordfish catch.

Trends in market prices are likely to have a significant impact on future Brazilian catch trends. As Brazilian prices are currently so low, even a small price increase could be significant. The expansion of the Brazilian swordfish fishery since 1993 has taken place in an era of relatively weak swordfish prices, especially during 1997 and 1998. Narrow profit margins constrain a company's ability to upgrade equipment or expand the fleet. Given the nature of price fluctuations in different fisheries, it is likely that swordfish prices will eventually rebound. This is especially true of swordfish given its wide market appeal in the United States. If and when swordfish prices do recover, there will be a much greater incentive for Brazilian fishermen to expand fishing effort. Further catch increases, however, will have to come from fleet expansion--either commercial or artisanal vessels. The Brazilian fishery has largely converted to U.S.-style monofilament operations, so unless new gear and methods are developed, further expanded catches are no longer likely to come from gear conversions.

The Brazilian Government has until recently not been an active participant in ICCAT. Now that ICCAT has instituted a south Atlantic management regime for swordfish and Brazilian fishermen are expanding their catches, Brazilian officials in recent years have played an increasingly active role in ICCAT consultations. Brazil and Uruguay can be expected to continue to strongly advocate changes in the existing ICCAT management regime to give increased preferences to coastal states in assigning allocations. Brazilian authorities constantly point to the very large share of the south Atlantic swordfish catch being taken by distant-water fishermen. This effort will only increase if prices for swordfish firm, providing improved incentives for Brazilian fishermen to expand the fishery.

The Brazilian Government is also likely to reassess the leasing program it has conducted since the 1970s with foreign fishermen. At the time the leasing program was initiated, few Brazilians had the technical capability to conduct pelagic longline fisheries. Many of the captains and technicians, even on domestic longliners, were of foreign origin. A new generation of Brazilians, however, has developed extensive expertise. Many have worked with foreign fishermen (Japan, the United States, Taiwan, and others) and the country now has the technical capability of conducting a significantly expanded fishery. The Government in 1998 froze the current licensing program at 1998 levels beginning in 1999. It is likely that Government officials will in the future curtail or terminate this program. This may be the case especially if ICCAT management regimes require further reductions in south Atlantic catches. The assessments by the ICCAT-SCRS suggest that such reductions in effort do appear to be necessary.

Brazilian companies are expanding the processing of value-added product. A few companies have for several years been producing small quantities of swordfish products. Most of this production is frozen product for sale domestically. The 1998 decline in swordfish prices has brought prices down to the point at which exports sales are not much higher than domestic prices. As a result, several companies are beginning to redirect product to domestic markets. In doing so they have been expanding value-added processing and retail packs. This expanded effort may eventually enable these companies to export value-added packs rather than just unprocessed trunks.

Some Brazilian industry groups are likely to promote efforts to address the serious quality problem the industry faces. The current low-prices received for Brazilian swordfish significantly reduces the profitability of the fishery. Some company representatives are promoting a quality assurance or inspection program, perhaps one awarding a seal to high-quality product. Brazil is, however, a large country and the industry is highly regional. While there is a strong financial incentive for the industry to address this problem, it is not yet clear if in the near future the industry can work out a consensus.

Brazilian researchers have not given great attention to swordfish. Only two research institutes (the IP and UFRPe) have done any serious work. Brazil has a small marine research effort and the emphasis has focused on species of greater commercial value or inshore and freshwater species that are easier to work with. Given the current financial and economic problems faced by the Brazilian Government, it is likely that research funding in 1999 and even 2000 will be curtailed. Research on highly migratory species like swordfish is difficult and expensive to conduct. Thus any new or expanded Brazilian research on swordfish is unlikely in the near future.

* * * *

Note: This chapter was designed and formatted by several student interns during the summer and fall of 1998.

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ENDNOTES

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3. Decreto-Lei N°221, February 28, 1967.

4. IBAMA, *Diagnóstico da Pesca Marítima do Brasil: Diretoria de Incentivo á Pesquisa e Divulgação* (Brasília: IBAMA, 1996), 82p.

5. J.P. Wise and J.C. Le Guen, "The Japanese Atlantic longline fishery, 1956-63," *Symp. Oceanogr. Fish. Res. Trop. Atlantic*, 1969, pp. 317-347.

6. A.C. Barros,"Algunos aspectos sobre a biologia e pesca de albacora-branca (*Thunnus alalunga Gmelin*) no Atlántico tropical," *Bol. Est. Pesca.* Recife, 1965, Vol. 5, No. 5, pp. 185-293.

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10. Wagner Oliviera Simoes, vessel captain, ALS Distribidora, personal communications, August 24, 1998.

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SECTION II (Species)

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15. For details on overall Korean fleet operations see the Korean chapter in Wildman, "Asia," *World Swordfish Fisheries*, Vol. III (NMFS: Silver Spring, Maryland, November 1997).

16. Korean National Fisheries Research and Development Agency, *Fishery Statistics and Fishing Grounds for the Korean Tuna Long Line Fishery, 1988-1992* (NFRDA: Seoul, December, 1993), pp. 87-434.

17. See the Uruguayan chapter of this report for details.

18. Taiwan Tuna Research Center (TRC), *Annual Catch Statistics of Taiwanese Tuna Longline Fishery* (Taipei: Tuna Research Center, December 1993), pp. F5-8.

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21. José Dias Neto and José Heriberto M. de Lima, "Technical considerations relevant for the allocation of catch quota for the south Atlantic swordfish stock," unpublished paper prepared in cooperation with a Brazilian working group under the framework of the SEGESP. The paper was prepared as a working document at a 1997 ICCAT meeting in João Pessoa.

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23. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

24. A. Ferreira Amorim and Carlos A. Arfelli, "Reproducción del pez espada (*Xiphias gladius, L.* 1758) en el sudeste y sur del Brazil," *Collective Volume of Scientific Papers*, Vol. IXX, 1979, SCRS/79/43 (ICCAT: Madrid, 1979), pp. 624-626; A. Ferreira Amorim and C.A. Arfelli, "Contribuição ao conhecimento da biologia e pesca do espadarte e agulhões no litoral sul-sudeste do Brásil, *Anais do I Congresso Paulista de Agronmia* (São Paulo: 1977), p. 197-199; and da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183.

25. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

26. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183.

27. J.N. Antero da Silva, "Acompanhamento da pesca de atuns e espinheleiros Japoneses arrendados por industrias Brasileiras em 1981," *Informe Tecnico*, No. 1 (PDP/SUDEPE: Rio Grande, RS: 1982), 17p.

27A. The IP data on swordfish catches and yields is summarized and analyzed in C.A. Arfelli, "Estudo da pesca e aspectos da dinâmica populacional de espadarte *Xiphias gladius* L 1758 no Atlântico sul," Tese de Doutorado, UNESP, Rio Claro, 175p. IP researchers have published numerous articles describing seasonal catch trends, including: C.A. Arfelli and A.F. Amorim, "Analysis on *Xiphias gladius* L. caught off south and southeast of Brazil (1971-1981)," ICCAT SCRS/1982; C.A. Arfelli and A.F. Amorim, "Catch per unit effort of Xiphiidae and Istiophoridae from Brazilian longliners (1971-1982) ICCAT SCRS/1983; A.F. Amorim and C.A. Arfelli, "Estudo biológico-pesqueiro do espadarte, *Xiphias gladius* Linnaeus, 1758, no sudeste e sul do Brasil (1971 a 1981)," *Boletim de Instituto de Pesca*, 1984, Vol. 11 (único), pp. 35-62; A.F. Amorim, C.A. Arfelli, and J.C. Galhardo-Amado, "Catch per unit effort of Xiphiidae and Istiophoridae from Brazilian longliners (1971-1982), *ICCAT Collective Volume of Scientific Papers*, 1985, Vol. XXIII, N°2, pp. 337-341; and O. Mora, C.A. Arfelli, J.N. Antero, A.F. Amorim, and C. Gregório, "Comparación de pesquerias de pez espada (*Xiphias gladius*) en el Atlantico sudoccidental," *ICCAT Collective Volume of Scientific Papers*, 1991, Vol. XXXV, N°2, pp.437-444.

28. Graphics based on data from the Japanese longline fishery, 1983-85. ICCAT, "Report of the Standing Committee on Research and Statistics," *ICCAT Report*, 1987, Part II, (ICCAT: Madrid, Spain, 1988), p. 206.

29. Castello, *op. cit.*, April 18, 1996.

30. Oswaldo Shoiti Babá, Kawai Suisan, personal communications, April 19, 1996.

31. R.J. Palko, G.L. Beardsley, W.J. Richards, "Synopsis of the biology of the swordfish, *Xiphias gladius* Linnaeus," *NOAA Technical Report* NMFS 441 (NOAA: Washington D.C., 1981).

32. J.C. Rey, "Comentario sobre las areas de reproducción del pez espada *Xiphias gladius* en el Atlantico y Mediterraneo," *ICCAT Col. Vol. Sci. Papers*, 1988, pp. 189-193.

33. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 12.

34. The spatial distribution of swordfish larvae is not fully understood. Some swordfish larvae have been found in subsurface collections. The R/V *DANA* expedition in the Sargasso Sea found that swordfish larvae were found in greatest numbers at 50-100 meters. A.V. Taning, "On the breeding ground of the swordfish (*Xiphias*)," *Pap. Mar. Biol. and Oceanogr.*, Deepsea Research Suppl., 1995, 3, pp. 438-450. Most studies, however, have encountered swordfish larvae in surface waters. Gorbunova, "Breeding grounds ...," *op. cit.*, pp. 375-387; Y. Nishikawa and S. Ueyanagi, "The distribution of the larvae of swordfish, *Xiphias gladius*, in the Indian and Pacific oceans," *NOAA Technical Report*, NMFS-SSRF 675, 1974, pp. 261-264; and H. Yabe, S. Ueyanagi, S. Kikawa, and H. Watanabe, "Study on the life-history of the swordfish, *Xiphias gladius* Linnaeus, *Rep. Nankai Regional Fishery Research Laboratory*, 1959, 10, pp.107-150. Of course finding the larvae most commonly at the surface dos not mean that they necessarily occur most commonly at the surface. Sampling frequency and collection methods can affect results. Relative abundance will be affected by larval size, water temperature, prey availability, and many other factors some of which almost certainly have not been identified. The authors know of no work off Brazil assessing spatial distribution of swordfish larvae.

35. Gorbunova, "Breeding grounds ...," *op. cit.*, p. 375.

36. A. Taning, "On the breeding ground of the swordfish (*Xiphias*), *Pap, Mar. Biol. and Oceanogr.*, Deepsea Research, 1995.

37. C.A, Arfelli, "Estudo sa pesca e aspectos da dinâmica populaçional de espadarte Xiphias gladius L. 1758, no Atlântico sul," Tese de Doutorado, UNESP, Rio Claro, 1996, 175p.

38. S. Ueyanagi, *et. al.*, "Distribution, spawning, and relative abundance of billfishes in the Atlantic Ocean," *Bull. Far Seas Fish. Res. Lab.*, Vol. III, 1970, pp. 15-55.

39. A.F. Amorim and C.A. Arfelli, "Reproduccion del pez espada, *Xiphias gladius*, L. (1758) en el sudeste sul do Brasil," *ICCAT Col. Vol. Sci. Papers*, 1980, 9 (3), pp. 624-626.

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41. Ueyabagi *et. al.*, "Distribution, spawning, and ...," *op. cit.*

42. Y. Sishikawa as cited in J.C. Rey, "Comentarios sobre las areas se reprocucción de pez espada (*Xiphias gladius*) en el Atántico y Mediterráneo," *Collected Volume of Scientific Papers* Vol. XXVII (ICCAT: Madrid, 1988), pp. 180-193.

43. G. Guitart-Manday, "Biologia pesquera del emperador o pez espada, *Xiphias gladius* Linnaeus (Teleostomi: Xiphiidae) en las aguas de Cuba," *Poeyana*, series B, N°1, June, 1964, 37p.

44. These researchers did not find swordfish larvae from October to December. Nishikawa as cited in Rey, "Comentarios sobre las areas ..., " *op. cit.*

45. Lutken as cited in N.N. Gorbunova, "Breeding grounds and food of swordfish *Xiphias gladius* Linne (Pisces Xiphilidae)," *Prob. Ichtyol*, 1969, Vol. IX, pp. 375-385.

46. V.V. Ovchinnikov, "Swordfish and billfishes in the Atlantic Ocean," *Atlantic Scientific Research Institute of Fisheries and Oceanography*, 1970.

47. A. Ferreira Amorim and Carlos A. Arfelli, "Reproducción del pez espada (*Xiphias gladius, L.* 1758) en el sudeste y sur del Brazil," *Collective Volume of Scientific Papers*, Vol. IX, 1979, SCRS/79/43 (ICCAT: Madrid, 1979) and A. Ferreira Amorim and Carlos A. Arfelli, "Estudo biológico-pesqueiro do espadarte, *Xiphias gladius* Linnaeus, 1758, no sudeste e sul do Brasil (1971 a 1981), *Boletim do Instituto de Pesca*, São Paulo, vo. 11, 1984, pp. 35-62.

48. S. Ueyanagi, *et. al.*, "*op. cit.*

49. Amorim and Arfelli, "Reproduccion del pez espada ...," *op. cit.*, pp. 624-626.

50. Mejuto Garcia, "A preliminary analysis ...," *op. cit.*

51. Almost all studies have focused on larvae. Finding eggs is a very difficult proposition in an oceanic species such as swordfish. The eggs hatch probably in a few hours. Only in one specific area of the Mediterranean have eggs been collected. Researchers have found very small larvae in various locations. One of the best studied areas is the U.S. Gulf of Mexico and Atlantic seaboard. See for example John Jeffrey Govoni, Bruce W. Stender, and Oleg Pasuk, "Distribution of larval swordfish, *Xiphias gladius*, and possible spawning off the southeastern United States," *Fisheries Bulletin*, in press, 1998.

52. Lutken, *op. cit.*

53. Gorbunova, "Breeding grounds ...," *op. cit.*, pp. 375-387.

54. Ueyabagi *et. al.*, "Distribution, spawning, and ...," *op. cit.*

55. Charlene Grall, Donald P. de Sylva, and Edward D. Houde, "Distribution, relative abundance, and seasonality of swordfish larvae," *Transactions of the American Fisheries Society*, Vol. 112, 1983, p. 238.

56. Ueyanagi, *et. al.* "Distribution, spawning, and relative abundance ...," *op. cit.*; Ovchinnikov, "Swordfish and billfishes ...," *op. cit.*; and Y.A. Vyalov and V.V. Ovchinnikov, "Main results of the tuna, swordfish, and sailfish studies in the Atlantic, Research Institute for the Fisheries Oceanography (ATLANTNIRO) for the 20 year period (1957-77) *Collective Volume of Scientific Papers* Vol. IX, No. 3, (Madrid: ICCAT, 1980), pp. 662-674. Soviet researchers surveying the available literature report, however, that the primary areas of spawning appear to be the western Atlantic, although more data is available on the northern than the southern Atlantic. Gorbunova, "Breeding grounds ...," *op. cit.*, p. 377.

57. This phenomenon can be seen in figures 1 and 2 of Grall, de Sylva, and Houde, "Distribution ...," p. 235.

58. A fuller description of this phenomenon is available in Dennis Weidner and Julio A. Serrano, "Chile," *World Swordfish Fisheries*, Vol. IV, Part A. Section 1, Segment B (NMFS: Silver Spring, Maryland, 1997), p. 479 and footnote 163.

59. It is unclear why swordfish spawning tends to occur in the western and central Pacific and Atlantic, but does not appear to occur in the eastern Pacific and at least not as extensively in the eastern Atlantic. One possible factor is the cold water currents which affect the eastern Pacific and eastern Atlantic: North America (Japan Current), South America (Humboldt/Chile-Peru Current), and Southern Africa (Benguela Current).

60. J. Mejuto, J.M. de la Serna, and B. Garcia, "Some considerations on the spatial and temporal variable in the sex-ratio at size of the swordfish (*Xiphias gladius* L.), *ICCAT Collective Volume of Scientific Papers*, XLVIII (1) (ICCAT: Madrid, 1998), pp. 205-215.

61. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

62. W.B. Scott and S.N. Tibbo, "Food and feeding habits of swordfish, *Xiphias gladius*, in the Northwest Atlantic," *Journal of the Fisheries Research Board of Canada*, Vol. 25, No. 5, 1968, pp. 903-919.

63. Arocha, *op. cit.*, January 17, 1999.

64. C.E. Stillwell and N.E. Kohler, "Food and feeding ecology of the swordfish *Xiphias gladius* in the Western North Atlantic Ocean with estimates of daily ration," *Marine Ecology*, Vol. 22, 1985, pp. 239-247.

65. Knut Schmidt-Nielsen, *Animal Physiology: Adaptation and Environment* (Cambridge University Press: New York, 1997).

66. Antero da Silva, "Acompanhamento da pesca ...," *op. cit.*

67. Menezes de Mello, "Aanlise de conteudos ..." *op. cit.*, p. 65. An excellent study on squid abundance and distribution off southern Brazil is available in Manuel Haimovici and Jose Angel Alvarez Perez, "Abundáncia e disrtibição de cefalópodes em cruzeiros de prospecção pesqueira demersal na plataforma externa e talude continental do sul do Brasil," *Atlántica* Vol. 13, N°1, 1991, p. 189.

68. Menezes de Mello, "Aanlise de conteudos ..." *op. cit.*, p. 65. Another researcher confirms that oceanic squid (primarily *Illex*) is the major prey item off southern Brazil. L.A. Zavala-Camin, "Hábitos alimentarias e distribição dos atuns e afins (Osteichthyes-Teleostei) e suas relações ecológicas com outras especies pelágicas das regiões sudeste e sul do Brasil," Tese de Doutorado-IOUSP: 237p.

69. F. Hazin, *op. cit.*, January 6, 1999.

70. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, pp. 38-9.

71. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 37.

72. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 36.

73. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183.

74. Abdiel Juárez Cerezo, UFRPe, personal communications, October 29, 1998.

75. Hazin, *op.cit.*, August 28, 1998.

76. C.A. Arfelli, "Estudo da pesca e aspectos da dinâmica populacional de espadarte, Xiphias gladius L. 1758, no Atlântico Sul, Rio Claro, Tese de Doutorado, 1996, UNESP.

77. See "Fishing Grounds: Oceanography" for details.

78. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 12.

79. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, pp. 23, 39, and 89.

80. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 40.

81. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, pp. 90-92 and 95-96.

82. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p.68.

83. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 27.

84. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 26.

85. Arocha, *op. cit.*, January 17, 1999.

86. The authors know of no detailed study assessing the cause of large bloodlines in some fish. Informal discussions with some NMFS scientists working on swordfish provided some speculation as to the possible cause. Water temperature appears to be a key factor. Typically fish with large brown bloodlines are taken in tropical waters, like the water off the Brazilian northeast. Mike Travis, NMFS, personal communications, December 8, 1998. Another biologists believes the enlarged dark bloodline in some fish may be associated with thermo-regulation. Norm Bartoo, NMFS, personal communications, December 2, 1998.

87. Swordfish maturation and the sexual variations in maturation are covered in some detail in the Chilean chapter of this study.

88. ICCAT-SCRS, "Report of the Standing Committee ..." (COM/97/17), *op. cit.*, p. 79.

89. C.D. Burnett, J.S. Beckett, C.A. Dickson, P.C.F. Hurley, and T.D. Iles, "A summary of releases and recaptures in the Canadian large pelagic fish tagging program 1961-86," *Canadian Data Report of Fisheries and Aquatic Sciences* 673, 1987.

90. Careful handling procedures are needed for tagging swordfish to ensure survival. Fish under 20 kg, in particular, are fragile. ICCAT-SCRS, "Detailed report," October 17, 1998, p. 8. Another problem associated with tagging swordfish is that commercial fishermen are much less willing to tag fish than are sport fishermen. As only a few swordfish are taken by sport fishermen, tagging programs for tunas, billfish, and oceanic sharks often provide little information on swordfish. Unequal tagging and resampling activities in different regions are another problem. Tagging programs in the south Atlantic have been very limited. Much of the available data in the north Atlantic comes from U.S. tagging programs working in the Gulf of Mexico, Atlantic seaboard and Caribbean waters. There is no program of similar magnitude in the south Atlantic, although the Brazilian Instituto de Pesca has done some important work.

91. Burnett, *et. al.*, "A summary of releases ...," *op. cit.*

92. See the Venezuelan chapter of this report for details on tagging results in the north Atlantic.

93. The swordfish was tagged by one of the Imai Pesca (Santos company) vessels. "Captura de meca marcada há 11 anos ajuda projecto do Instituto de Pesca," *A Tribuna*, November 6, 1993. The IP tagging program was primarily focused on sharks, but tunas, billfish, and swordfish were also marked. "Pescador recebe prêmio por comunicar captura de cação com registro dos EUA," *A Tribuna*, September 12, 1992, and "Instituto de Pesca recebe agulhão," *Tribuna*, July 26, 1997.

94. Amorim, *op. cit.*, August 24, 1998 and Wes Pratt, NMFS Narragansett Lab, personal communications, October 27, 1998.

95. Patricia E. Rosal and Barbara A. Block, "Mitochondrial control region variability and global population structure in the swordfish, *Xiphias gladius*," and Barbara A. Block, "Progress report as of June 1995: Analysis of swordfish population structure using mitochondrial and nuclear DNA technologies," internal annual report for the Pelagic Fisheries Research Program at the University of Hawaii.

96. Jaime R. Alvarado Bremer, Jaime Mejuto, and Bert Ely, "Genetic population structure of swordfish: Lessons for the Atlantic Ocean and Mediterranean Sea," poster session at the Second International Symposium on Pacific Swordfish, March 3-5, 1997, Turtle Bay, Oahu, Hawaii and Jaime R. Alvarado Bremer, Jaime Mejuto, Thomas W. Greig, and Bert Ely, "Global population structure of the swordfish (*Xiphias gladius* L.) as revealed by analysis

of the mitochondrial DNA control region, *Journal of Experimental Marine Biology and Ecology*, 197 (1996), p. 308.

97. Alvarado Bremer *et.al.*, "Global population structure ...," p. 308.

98. Alvarado Bremer *et.al.*, "Global population structure ...," p. 304.

99. Naritushi Cho, "An attempt to clarify genetic stock structure of swordfish using nuclear gene markers," presentation at the Second International Symposium on Pacific Swordfish, March 5, 1997, Turtle Bay, Oahu, Hawaii.

100. Carol Reeb and Barbara Block, "Genetic analysis of Pacific swordfish populations using mtDNA and microsatellite markers," presentation at the Second International Symposium on Pacific Swordfish, March 5, 1997, Turtle Bay, Oahu, Hawaii.

101. Thomas Greig, University of South Carolina, personal communications, July 1, 1998.

102. Greig, *op. cit.*, July 1, 1998.

103. Jaime R. Alvarado Bremer, Jaime Mejuto, Thomas W. Greig, and Bert Ely, "Global population structure of the swordfish (*Xiphias gladius* L.) as revealed by analysis of the mitochondrial DNA control region, *Journal of Experimental Marine Biology and Ecology*, 197 (1996), pp. 295-310.

104. Jaime Alvarado Bremer, J.R. Mejuto, and B. Ely, "Genetic population structure of swordfish: Lessons for the Atlantic Ocean and Mediterranean Sea, poster board, Second International Symposium on Pacific Swordfish, March 5, 1997, Turtle Bay, Oahu, Hawaii.

105. Rosal and Block, "Mitochondrial control ...," *op. cit.*

106. Dupuy, *op. cit.*, September 10, 1998; and Johnson, *op. cit.*, September 15, 1997.

107. Carlos Arfelli, Sub-Director, Instituto de Pesca, personal communications, August 24, 1998.

108. Pratt, *op. cit.*, October 27, 1998 and Amorim, *op. cit.*, August 24, 1998.

109. A.F. Amorin, C. Arfelli, A. González-Garcés, and J.C. Rey, "Estudio comparativo sobre la biologia y pesca del pez espada, *Xiphias gladius* L. (1758), obtenidos por las flotas española y brasilleña," *ICCAT Collective Volume of Scientific Papers*, Vol. VIII, SCRS/78/51, (ICCAT: Madrid, Spain, 1979), pp. 496-503.

110. Arfelli, *op. cit.*, July 16, 1996.

111. Rogerio Menezes de Mello, "Aanlise de conteudos estomacais, intensidade de alimentação, idade e crescimento do espadarte, *Xiphias gladius* (Xiphioidei: Xiphiidae), no sul do Brasil," MS Thesis, (Universidade do Rio Grande: Rio Grande, Brazil, October, 1992), pp. 21 and 33.

112. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 32.

113. The researcher concludes that this is similar to reports from other Atlantic fisheries. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 45.

114. Arfelli, *op. cit.*, July 16, 1996.

115. ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics*, 1997, *op. cit.*, table SWO-Figure 5.

116. ICCAT-SCRS, "Report of the Standing Committee ...," (COM/97/17), *op. cit.*, p. 82.

117. Jorge Pablo Castello, Researcher, Fundação Universidade de Rio Grande (FURG), personal communications, April 18, 1996.

118. The CPUE pattern is very similar if calculated by number of fish instead of weight. Rogerio Menezes de Mello, Teodoro Vaske Jr., and Jorge P. Castello, "Pesqueria de atunes y pez espada por la flota arrendada de Rio Grande, Brazil," *Frente Marítimo*, Vol. 14, Sec. A, 1993, p. 131., pp. 129-130.

119. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 26.

120. Roberto K. Imai, Manager, IMAIPESCA, personal communications, April 19, 1996.

121. Neves and Olmos, "Albatross mortality ...," *op. cit.*

122. J. Mejuto, J.M. de la Serna, and B. García, "Updated standardized catch rates by age, sexes combined, for the swordfish (*Xiphias gladius*) from the Spanish longline fleet in the Atlantic, for the period 1983-1996," *Collected Volume of Scientific Papers*, Vol. XLVIII (1) (ICCAT: Madrid, 1998), pp. 216-222.

123. ICCAT, "Critical review of the data collection and processing system of Chinese Taipei, and revision of statistics for its longline fleet,"*Collective Volume of Scientific Papers* Vol. XLVIII (3) (ICCAT: Madrid, 1998), pp. 141-156.

124. ICCAT-SCRS, "Report of the Standing Committee," (COM/97/17), *op. cit.*, p.81.

125. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 9.

126. A good historical review of tuna fisheries is available in Melquíades Pinto Paiva, *Abundãncia de Atuns ao Largo da Costa do Brasil* (Brasilia: Associação dos Engenheiros de Pesca do Distrito Federal, 1982, 103 p. A more recent review of tuna operations is available in Luis Alberto Zavala-Camin and Jose Nelson Antero da Silva, "Histórico da pesquisa e pesca de atunes com espinhela Brasil, *Atlãntica*, Vol. 13, No. 1, Rio Grande, 1991, pp. 107-114.

127. Y. Uozumi, "Preliminary analysis on the distribution of sailfish and longbill spearfish in the Atlantic Ocean in 1993 based on the logbook data," *ICCAT Collective Volume of Scientific Papers* (ICCAT: Madrid, Spain, 1995), p. 29.

128. Carolus Maria Vooren, Fundação Universidade de Rio Grande, personal communications, April 16, 1996.

129. ICCAT-SCRS, "Report of the Standing Committee ...," (COM/97/17), *op. cit.*, p. 81 and ICCAT-SCRS, "Report on the Standing Committee on Research and Statistics," (COM/98/16) Madrid, October 19-23, 1998.

130. An overview of flag-of-convenience registrations in Latin America is available in Weidner and Hall, "Latin America," *op. cit.*, pp. 20-27.

131. ICCAT-SCRS, "Report of the Standing Committee ...," (COM/97/17), *op. cit.*, p. 81.

132. A good discussion of the problem from the Spanish perspective is available in "El sector del pez espada en su peor momento," *Industrias Pesqueras*, September 1998, pp. 3-12.

SECTION III (Fishing Grounds)

133. An excellent collection of studies is available in U. Seeliger, C, Odebrecht, and J.P. Castello (editors, *Subtropical Convergence Environments, the Coast and sea in the Southwestern Atlantic* (Springer Verlag, Heidelberg, 1997), 308p. The contributors are mostly researchers at the University of Rio Grande and the University of Vale do Itajaí.

134. A detailed discussion of he oceanic dynamics in the southwestern Atlantic is available in Seeliger, *et. al., Subtropical Convergence ... op. cit.*

135. Castello, *op. cit.*, April 18, 1996.

136. For a discussion of the Caribbean current regime, see the Venezuelan chapter of this report.

137. A more detailed discussion of the Guyana and North Brazil Currents is available in Matthias Tomczak and J. Stuart Godfrey, *Regional Oceanography: An Introduction* (Pergamon: London, 1994), pp. 271-272.

138. P.L. Richardson, G. Hufford, R. Limeburner, and W. Brown," North Brazil Current retroflection eddies," *J. Geophys. Res.* 99, 1994, pp. 5081-5093.

139. Castello, *op. cit.*, April 18, 1996.

140. Hazin, *op. cit.*, July 3, 1996.

141. Castello, *op. cit.*, April 18, 1996.

142. See for example D.J. DeMaster, B.A. McKee, W.S. Moore, D.M. Nelson, W.J. Showers, and W.O. Smith, "Geochemical processes occurring in the waters at the Amazon River/ocean boundary," *Oceanography*, 4, 1991, pp. 15-20; W.R. Geyer, "Tide-induced mixing in the Amazon frontal zone," *J. Geophys. Res.*, 100, 1995, pp. 2341-2353; W.R. Geyer, R.C. Beardsley, J. Candela, B. Castro, R. Legeckis, S.J. Lentz, R. Limeburner, L. Miranda, and J.H. Trowbridge, "The physical oceanography of the Amazon outflow," *Oceanography*, 4, 1991, pp. 8-14; W.R. Geyer and G.C.Kineke, "Observations of currents and water properties in the Amazon frontal zone, *J. Geophys. Res.*, 100, 1995, pp. 2321-2339; S.J. Lentz, "Seasonal variations in the horizontal structure of the Amazon Plume inferred from historical hydrographic data," *J. Geophys Res.* 100, 1995, pp. 2391-2400; S.J. Lentz, "The Amazon River Plume during AMASSEDS: Subtidal current variability and the importance of wind forcing," *J. Geophys. Res.*, 100, 1995, pp.2377-2390; R. Limeburner, R.C. Beardsley, I.D. Soares, S.J. Lentz, and J. Candela, "Lagrangian flow observations of the Amazon River discharge into the North Atlantic," *J. Geophys. Res.*, 100, 1995, pp. 2401-2415; and W.O. Smith and G.J. Russell, "Phytoplankton biomass and nutrient distributions in the Amazon River plume: Environmental correlates," *Geo-Mar. Letts*, 15, 1995, pp. 195-198.

143. Considerable research exists on the dynamics of the Patos Lagoon. See for example Seeliger, *Subtropical Convergence ... op. cit.*

144. Tomczak and Godfrey, *Regional Oceanography, op. cit.*, p. 270.

145. Castello, *op. cit.*, April 18, 1996.

146. Tomczak and Godfrey, *Regional Oceanography, op. cit.*, p. 270.

147. R. Legeckis and A.L. Gordon, "Satellite observations of the Brazil and Falklands Currents - 1975 to 1976 and 1978," *Deep-Sea Research*, Vol. 29, 1982, pp. 375-401.

148. Tomczak and Godfrey, *Regional Oceanography, op. cit.*, p. 270.

149. J. Nelson Antero da Silva, "Tuna fishery in Brazil by leased Japanese longliner fleet from 1977 to 1991," *ICCAT Collective Volume of Scientific Papers*, Report of the Second ICCAT Billfish Workshop, Miami, Florida, July 22-29, 1992 (ICCAT: Madrid, 1994, p. 183.

150. Castello, *op. cit.*, April 18, 1996.

151. Zavala-Camin, Histórico da pesquisa ...," *op. cit.*, pp. 109-110.

152. Miles, "Recent developments ..., *op. cit.*, p. 188.

153. Cecil Miles, "Recent developments in the Brazilian fisheries," *Proceedings of the 14th Annual Session of the Gulf and Caribbean Fisheries Institute* (GCFI: Miami, April, 1962), pp. 186-188.

154. Y. Matsuura, "A probable cause of recruitment failure of the Brazilian sardine *Sardinella aurita* population during the 1974/75 spawning season," *South African Journal of Marine Science*, 1996, Vol. 17, pp. 29-35.

155. Off the Brazil's southern coast and off Uruguay other pelagic species become more important, including anchovy, jack mackerel, and squid.

156. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

157. Menezes de Mello, "Analise de conteudos ...," p. 42.

158. D. Olson, G. Podesta, R. Evans, and O. Brown, "Temporal variations in the separation of the Brazil and Malvinas currents, *Deep Sea Research*, Vol 35 (1988), No. 12, 1971-1990.

159. T. Vaske Jr. and J.P. Castello, "Composición cualicuantitiva de la dieta alimentica de los atunes, aleta amarilla (*Thunnus albacares*) a albacora (*Thunnus alalunga*) en el extremo sur de Brasil," *Resumos do VIII Simp. Com. Téc Mix Fr. Mar*, 1991, 54.

160. Menezes de Mello, "Analise de conteudos ...," *op. cit.*, p. 51.

161. Guillermo Podesta, "Aspects of swordfish oceanography in the Atlantic," Second International Swordfish symposium, Turtle Bay, Hawaii, March 4, 1997.

162. Podesta, *op. cit.*, June 16, 1997.

163. ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics* (COM/97/17) Madrid, October 20-24, 1997, Figure 1, p.86.

164. Dias Neto, "Technical considerations ...," p.4.

165. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 231 and SUDEPE, "National report of Brazil," *ICCAT Report* Part II, 1986-87 (ICCAT: Madrid, Spain, 1987), p. 254.

166. Neves and Olmos, "Albatross mortality ...," *op. cit.*

167. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 181.

168. Neves and Olmos, "Albatross mortality ...," *op. cit.*

169. J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1990-91 (ICCAT: Madrid, Spain, 1991), p. 406 and J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1991-92 (ICCAT: Madrid, Spain, 1993), pp. 333-334.

170. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

171. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 231. In another later report fishing off the Ascension Island peak during the spring and summer months. Meneses de Lima, "National report of Brazil," 1990-91, *op. cit.*, p. 407.

172. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, pp. 183 and 187 and Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 125, 128-129. The actual statistical block continues south to 35°S, but theoretically the Japanese are only setting in Brazilian waters.

173. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182.

174. Dias *et. al.*, "Technical considerations ...," *op. cit.*, figure 1.

175. Y. Marin, INAPE, personal communications, May 12, 1998.

176. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182.

177. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182.

178. Meneses de Lima, "National ..." *op. cit*, 1992, p. 334.

179. Y. Marin, INAPE, personal communications, May 12, 1998.

180. Several Brazilian companies have told the authors that the initiative for these arrangements comes primarily from foreign companies. A.D. Da Silva, *op. cit.*, April 17, 1996; Hadrich, *op. cit.*, April 17, 1996; Imai, *op. cit.*, April 19, 1996; and Shoiti Babá, *op. cit.*, April 19, 1996.

181. See the Barbados chapter of this report for details.

182. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

183. Dias *et. al.*, "Technical considerations ...," *op. cit.*, figure 1.

SECTION IV (Fleet)

184. J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 333.

185. Hazin, *op. cit.*, April 21, 1998.

186. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 230.

187. Silva, *et.al.*, "White marlin ...," *op. cit.*, p. 190.

188. Alberto Amorim, Instituto de Pesca, Santos, personal communications, March 1, 1996.

189. F.H.V. Hazin, J.R. Zagaglia, M.K. Broadhurst, P.E.P. Travassos, T.R.Q. Bezerra, "Review of a small-scale pelagic longline fishery off northeastern Brazil," paper submitted for publication in 1998 and advanced copy supplied to the authors.

190. Silva, *et. al.*, "White marlin ...," *op. cit.*, p. 190.

191. J.H. Meneses de Lima, "National report of Brazil - 1991," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 250.

192. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (I), p. 138.

193. Amorim, *op. cit.*, March 1, 1996.

194. Fabio Hazin, personal communications, April 21, 1998.

195. Aracod Aronovski, ALS Distribuidora, personal communications, August 24, 1998.

196.Amorim, op.cit., August 24, 1998.

197. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (I), p. 138.

198. Amorim, *op. cit.*, March 1, 1996.

199. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (I), p. 138.

200. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (I), p. 138.

201. Amorim, *op. cit.*, March 1, 1996.

202. Olveira Simoes, *op. cit.*, August 24, 1998.

203. Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pessca: Universidade Federal Rural de Pernambuco, 1998), p. 31.

204. Gomes Hazin and Hazin, *Análise da Viabilidade ...*, *op. cit.*, 31. Labor was not included as a cost, perhaps because the fishermen are paid as a share of the resulting catch.

205. For details see the Barbados chapter of this report.

206. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 181-182.

207. Sjef van Eijs, INFOPESCA, personal communications, October 6, 1995.

208. Hazin, *op. cit.*, July 15, 1996.

209. Meneses, "National ..." 1992, *op. cit.*, p.333.

210. Hsu Ming Hong, China Sea, personal communications, July 16, 1966.

211. Da Silva, *op. cit.*, May 15, 1996.

212. Wildman, "Japan", *World Swordfish Fisheries*, *op. cit.*, p.33.

213. Wildman, "Korea", *World Swordfish Fisheries*, *op. cit.*, p. 82.

214. Claudio Ibañez, Rosu Tercero, personal communications, July 18, 1996; Rodrigo Duran, Dumar, personal communications, July 3, 1996; and Alfonso Garcia, co-owner, *Arosa Primera*, personal communications, June 21, 1996.

215. A. Garcia, *op. cit.*, June 21, 1996.

216. Wildman, "Taiwan", *World Swordfish Fisheries*, *op. cit.*, p. 113.

217. Meneses de Lima, "National report of Brazil - 1991," *op. cit.*, p. 250.

218. Silva, "Perfil pesqueiro ...," *op. cit.*, p. 5.

219. Silva, "Perfil pesqueiro ...," *op. cit.*, p. 6.

220. Hazin, *op. cit.*, February 11, 1998.

SECTION V (Shipyards)

221. "Brazil - builders and manufacturers," *World Fishing*, September, 1985, p. 28.

222. "Brazil - builders" *op. cit.*, p. 28.

223. "Brazil: del anzuelo al astillero," *Tecnica Pesquera*, April, 1976, p. 38.

224. "Naval fishing industry in Brazil," *Revista Nacional da Pesca*, October, 1974, p. 32.

225. "Naval fishing industry," *op. cit.*, p. 32.

226. Imai, *op. cit.*, April 20, 1996.

227. Diego Carlos Mário Foscolos, IBAMA Director, Santos, personal communications, April 19, 1996.

228. INFOPESCA, "Nuevo atunero para FEMEPE *Adolfo José*, *Noticias Comerciales*, July 5, 1991.

SECTION VI (Fleet Operations)

229. FAO, "Report to the Government of Brazil on tuna fisheries development (northeast coast of Brazil)" *FAO Report* No. 739 (FAO: Rome, 1957), 29p.

230. Neves and Olmos, "Albatross mortality ...," *op. cit.*

231. Hazin, *op. cit.*, April 21, 1998.

232. The Honduran and Panamanian vessels are flag-of-convenience vessels with foreign owners. Several of these vessels active off Brazil have United States, Spanish, and other foreign owners.

233. Imai, *op. cit.*, April 19, 1996.

234. For details on the Japanese fishery, see the Japanese chapter of this study. Wildman, "Asia," *op. cit.*

235. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182.

236. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182.

237. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182.

238. J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), p. 230.

239. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 230.

240. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182.

241. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 125.

242. The fishery is described in C.A. Arfelli and A.F. Amorim, "Description of the Brazilian swordfish fishery in Santos," *ICCAT SCRS*, 87/83, pp. 315-317.

243. The Honduran vessel was presumably a flag-of-convenience vessel, probably owned by a Taiwan company. For details on Honduran flag-of-convenience licensing policies see Weidner and Hall, "Latin America," *op. cit.*

244. Sjef van Eijs, INFOPESCA, personal communications, October 6, 1995.

245. Duarte da Silva, *op. cit.*, April 17, 1996.

246. Shoita Babá, *op. cit.*, April 19, 1996.

247. Imai, *op. cit.*, April 19, 1996 and Shoiti Baba, *op. cit.*, April 19, 1996.

248. One Brazilian fisheries observer described his consternation when hailed by the Brazilian Navy at sea. The Japanese captain was so incensed about having to use the American system that he locked himself in his cabin and spent most of the trip drinking. He was so drunk when the vessel was hailed that the observer and the American fisheries adviser had to answer for him.

249. A.F. Amorim and C.A. Arfelli, "Revision on statistical data of the Brazilian longliners based in Santos - SP (1971-90)," Report of the Second Billfish Workshop, *ICCAT Collective Volume of Scientific Papers*, Vol. 61, 1994, pp. 169-179.

250. A.F. Amorim and C.A. Arfelli, "Estudo biológico-pesqueiro do espadarte, *Xiphias gladius* L. (1758) en el sudeste sul do Brasil (1971-1981), *B. Inst. Pesca* São Paulo, 11 (unico), 1984, pp. 35-62.

251. The night sharks are found only over these shallow oceanic banks. The fishermen are primarily interested in the blue sharks; catch rates are much lower than for the other species. Most of the night shark population is made up of sub-adults. Copulation and ovulation happens mainly in November and December. Hazin, *op. cit.*, July 31, 1996. A good overall review of pelagic fishing operations off the northeast has been prepared by UFRPe researchers. They found that domestic using Japanese multi-filament gear reported catches consisting of tunas (30 percent), sharks (54 percent), billfish including swordfish (12 percent), and other species (4 percent).
F.H.V. Hazin, J.R. Zagaglia, M.K. Broadhurst, P.E.P. Travassos, T.R.Q. Bezerra, "Review of a small-scale pelagic longline fishery off northeastern Brazil," paper submitted for publication in 1998 and advanced copy supplied to the authors.

252. See: "Research." A good review of the REVIZEE program is avaialable in IBAMA, *Programa REVIZEE* (REVIZZE: Brasilia, undated probably 1998), 32p.

253. Hazin, *op. cit.*, July 31, 1996.

254. C.A. Arfelli, "Estudo de pesca e aspectos da dinãmica populacional de espadarte, *Xiphias gladius* L. 1758, no Atántico Sul," Tese (Doutorado em Ciências Biológicas, Area de Zoologia), UNESP, Rio Claro, 175p.

255. Vooren, *op. cit.*, April 16, 1996.

256. C.A. Arfelli and A.F. Amorim, "Description of the swordfish fishery in Santos," *ICCAT Collected Volume of Scientific Papers*, Vol. 27, pp. 315-317 and Neves and Olmos, "Albatross mortalities ...," *op. cit.*

257. A.F. Amorim and C.A. Arfelli, "Estudo biológico-pesqueiro do espadarte, *Xiphias gladius* Linnaeus, 1758, no sudeste e sul de Brasil (1971 a 1981)," *Boletim Instituto de Pesca*, São Paulo, Vol. 11 (único), pp. 35-62.

258. Carlos Arfelli, Instituto de Pesca, Santos, personal communications, July 17, 1996 and Neves and Olmos, "Albatross mortalities ...," *op. cit.*

259. Vooren, *op. cit.*, April 18, 1996.

260. No one knows if the light sticks attract the swordfish or the prey species, which in turn, attracts the predator fish. In actual practice both are probably true.

261. Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

262. Foscolos, *op. cit.*, April 19, 1996.

263. Neves and Olmos, "Albatross mortality ...," *op. cit.* and Dias *et. al.*, "Technical considerations ...," *op. cit.*, p. 4.

264. Araújo Neto, *op. cit.*, April 19, 1996.

265. Amorim, *op. cit.*, April 19, 1996.

266. Amorim, *op. cit.*, April 19, 1996.

267. Neves and Olmos, "Albatross mortality ...," *op. cit.* The use of bioluminescent dyes is a practice U.S. swordfish fishermen picked up from recreational rod-and-reel fishermen.

268. The FURG researcher is Carlos Alberto García at the Department of Physical Oceanography. Vooren, *op. cit.*, April 18, 1996.

269. For background on flag-of-convenience vessels see Weidner and Hall, "Latin America, *World Fishing Fleets*, Vol. IV (NMFS: Silver Spring, Maryland, 1994).

270. Anderson Elles, *op. cit.*, April 17, 1996.

271. Hadrich, *op. cit.*, April 17, 1996.

272. J.N. Antero da Silva, "Atunes e afines: relatório do desempenho da frota atuniera de espinheleiros, sediada em Rio Grande (RS), no período de 1977 a 1989," *Coleção Melo Ambiente*, Série Estudos: Pesca, IBAMA, No. 3, 31p. and Menezes de Lima, "National report of Brazil," 1990-91 *op. cit.*, p. 407. Greater detail on the Japanese gear is available in Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 181.

273. Antero Silva, "Atunes e afines ...," *op. cit.* and Menezes de Mello, Vaske, and; Castello, "Pesqueria ...," *op. cit.*, p. 126.

274. Vooren, *op. cit.*, April 18, 1996.

275. Antonio B. Anderson Elles, President, and Carlos Roberto Silva Medeiros, Treasurer, Sindicato dos Pescadores de Rio Grande, personal communications, April 17, 1996.

276. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 126 and Antero Silva, "Atunes e afines ...," *op. cit.*

277. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 126.

278. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 182 J. Nelson Antero da Silva, personal communications, June 26, 1996.

279. Arfelli, *op. cit.*, July 17, 1996.

280. J.N. Antero Silva, personal communications, May 15, 1996.

281. Hadrich, *op. cit.* April 17, 1996.

282. Antero Silva, *op. cit.*, May 15, 1996.

283. Differences in the United States and Spanish longline system are discussed in more detail in the Uruguayan chapter of this study.

284. For details on the structure of the Spanish industry see William Folsom, "Europe," *World Swordfish Fishery* (NMFS: Silver Spring, 1997).

285. Hsu Ming Hong, China Sea, personal communications, July 16, 1996.

286. "Brazil's fishing industry, 1962" *Market New Leaflet*, number 80 (Bureau of Commercial Fisheries: Washington, DC, May 1963), p. 2.

287. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 231.

288. ICCAT, "Report of the Standing Committee on Research," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 98.

289. "Brazil's fishing industry, 1962," *op. cit.*, p. 2 and FAO, "Brazil" *Fishery Country Profile*, FID/CP/BRA/Rev.3, October 1983. An excellent historical look at the Brazilian artisanal fishery is available in Jack E. Conner, Fishing industry of Brazil," *Fishery Leaflet*, No. 329 (Bureau of Commercial Fisheries: Washington, D.C., September 1948), 42p.

290. IBAMA has developed a new data collection system in Ceará and plans to extend it to other northeastern states to obtain data on artisanal landings. ICCAT, "Report of the Standing Committee on Research," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 98.

291. Brazil does have a commercial purse seine fishery for sardines and skipjack tuna. The sardine fishery has harvested substantial quantities. But landings are only a small fraction of those reported in Chile and Peru and these fisheries do not dominate the industry as has been the case in both Chile and Peru.

292. Silva, "Perfil pesqueiro ...," p. 19 and Fabio Olmos, personal communication, January 14, 1999.

293. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 231.

294. Meneses de Lima, "National report of Brazil - 1991," *op. cit.*, p. 250.

295. Matsuura, *op. cit.*, January 11, 1998.

296. Vooren, *op. cit.*, April 18, 1996.

297. See "Bycatch" for details.

298. Gomes Hazin and Hazin, *Análise da Viabilidade ...*" *op. cit.*, pp. 31-36.

299. Hazin, *op. cit.*, February 11 and May 1, 1998.

300. Abdiel Arturo, UFRPe, personal communications, October 10, 1998. The project is being led by Fabio Hazin and a visiting Australian fisheries specialist, Mat Broadhurst, is providing technical assistance.

301. Arturo, *op. cit.*, December 22, 1998.

302. F. Olmos, "Seabirds attending bottom long-line fishing off southeastern Brazil,"*Ibis*, Vol. 119, pp. 685-691 and T. Neves and F. Olmos, "Albatross mortality in fisheries off the coast of Brazil," in G. Robertson and R. Gales, *Albatross Biology and Conservation* (Chipping Norton: Surrey Beatty & Sons, in press), pp. 214-219 and Melquíades Pinto Paiva and Magda Fernandes de Andrade-Tubino, "Produção, esforço e produtividade da pesca de linheiros ao largo da costa sudeste do Brasil (1979-1995)," *Boletim de Recursos Pesqueiros* No. 1, March 1998, 21p.

303. Arfelli, *op. cit.*, January 20, 1999.

304. See an available list of charter boats indicating the many available boats in São Paulo state: http://www.antares.com.br/cbpds/html/pespagu.htm

305. Valmir Ferreira de Silva, Casa Caça e Pesca Pinheriros, personal communications, November 18, 1998.

306. The Confederaço Brasileira de Pesca e Desportos maintains a complete, updated list of fishing clubs on its web site at: http://www.antares.com.br/~cbpds/brazil1.htm

307. Some Brazilian writers spell Ilhabela (Beautiful Island) as two words. The authors are unsure as to the correct form, but the one word form appears the most common.

308. Amorim, *op. cit.*, April 20, 1996.

309. IGFA, "22nd annual IGFA fishing contest winners," *The International Angler*, January-February, 1998, pp. 8-14 and IGFA, "Recent additions to IGFA special clubs," *The International Angler*, January-February, 1998, pp. 15-16. An abbreviated version of these appendices is available in the Venezuelan chapter of this study (appendices D8a and b).

310. South Fishing, internet posting (http://www.southfishing.com/billfish/html), retrieved May 11, 1998.

311. Reported in the Hotel Itapemar web page, retrieved November 19, 1998, (http://www.itapemar.com.br/Oceano.htm). The hotel is located on Ilhabela

312. Marcio Dottore "O milagre dos peixes," *Nautica*, No. 101, January 1997.

313. Reported in the Hotel Itapemar web page, retrieved November 19, 1998, (http://www.itapemar.com.br/Oceano.htm). The hotel is located on Ilhabela. The commercial fishery has also reported declining catches of white marlin (appendix E4b7). White marlin catches had been very important in some years, occasionally exceeding the catch of sailfish.

314. Ferreira de Silva, *op. cit.*, November 18, 1998.

315. ICCAT, "Report of the meeting of the standing committee on research and statistics," *ICCAT Report* Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), p. 212.

316. Amorim, *op. cit.*, August 24, 1998.

317. McIntosh, *op. cit.*, November 18, 1998.

318. Amorim, *op. cit.*, April 24, 1996.

319. Petrobras is interested in the project because artisanal fishermen are currently using offshore drilling platforms as FADs and fishing around them. Petrobras is worried about interactions, especially fire hazards, and is hopeful that a sound FAD program would reduce operations around the offshore oil platforms.

320. Greg McIntosh, McIntosh Marine, personal communications, November 18, 1998.

321. The CBPDS list of absolute national records is available at: http://www.antares.com.br/cbpds/html/tab1.htm, retrieved November 19, 1998.

322. Reported in the Hotel Itapemar web page, retrieved November 19, 1998, (http://www.itapemar.com.br/Oceano.htm).

323. Dottore, "O milagre ...," *op. cit.*

SECTION VII. (Catch)

324. For details on the Spanish swordfish fishery see the Spanish chapter in Folsom, "Western Europe," *op. cit.*

325. Details on the swordfish longline fisheries of these countries is available in Wildman, "Asia," *World Swordfish Fisheries*, Vol. IV, *op. cit.*

326. Dias Neto, *et. al.*, "Technical considerations ...," *op. cit.*, p. 3.

327. See the Spanish chapter in Folsom, "Western Europe," *World Swordfish Fishery*, *op. cit.*

328. Dias Neto, *et. al.*, "Technical considerations ...," *op. cit.*, p. 3.

329. Arfelli and Amorim, "Description ...," *op. cit.*

330. Brazilian officials report that sharks comprise most of the catch of the Brazilian vessels based in Santos and about a quarter of the catch of the smaller fleet operating off the northeast coast. Meneses de Lima, "National report of Brazil - 1991," *op. cit.*, p. 250. Statistical tables attached to the article, however, do not show such a large shark catch.

331. J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1990-91 (ICCAT: Madrid, Spain, 1991), p. 407.

332. The smaller albacore and bigeye catches appear to be due more to increasing effort on shark than to a decline of tuna stocks. Meneses de Lima, "National report of Brazil," ICCAT Report 1990-91, Part I (ICCAT: Madrid, 1991), p. 407.

333. The Japanese during the late 1970s reported high catches of white marlin and sailfish off Espirito Santo and Rio de Janeiro states (about 20°S) during the spring and summer. As the fishermen were primarily targeting tunas and the billfish had a lower market price, the fishermen moved to alternative grounds. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183.

334. Meneses, "National ..." 1992, *op. cit.*, p.334.

335.This is one reason a new Departamento de Pesca was established in the Agriculture Department in 1998. The industry hopes the new Department can initiate an effective statistical system. R. Hazin, *op. cit.*, August 26,1998.

336. Wise and Le Guen, "The Japanese...," *op. cit.*

337. Robert E. K. D. Lee, "Report to the Government of Brazil on tuna fisheries development (Northeastern coast of Brazil)," *FAO Report*, N°739 (FAO Expanded Technical Assistance Program: Rome, 1957), p. 29.

338. SUDEPE, "National report of Brazil," 1986-87 *op. cit.*, p. 254. Another observer reports that the Japanese commercial operations began in 1958. Barros, "Algunos aspectos ...," *op. cit.*

339. SUDEPE, "National Report of Brazil," 1986-87 *op. cit.*, p. 254.

340. Lee, "Report to the Government ..., *op. cit.*, p. 17.

341. Arfelli and Amorim, "Description of the Brazilian swordfish fishery ...," *op. cit.*

342. Manoel Nino de Morais, "Whatever happened to tuna fishing," *Revista Nacional de Pesca*, October, 1966, p. 7.

343. It is not unusual to find reports exaggerating foreign fishing activities in Latin American press reports.

344. Barros, "Algunos aspectos ...," *op. cit.*

345. SUDEPE, "National report of Brazil," 1986-87 *op. cit.*, p. 254.

346. Nino de Morais, "Whatever happened ...," *op. cit.*, p. 7.

347. De Kanel, "SUDEPE fosters ...," *op. cit.*, p. 1.

25. J.F. Cruz, *et. al.*, "Sobre a biologia pesqueira da albacora, *Thunnus Atlanticus* (lesson), no Nordeste do Brasil," *Bol. Inst. Biol. Mar. Univ. Fed. R.N.*, Natal, December 1964, p. 15.

349. After the initial 1958-61 Santos venture failed, another Santos company acquired two longliners in 1965. Arfelli and Amorim, "Description of the Brazilian swordfish fishery ...," *op. cit.* Another source suggests that a four-vessel longline fleet was deployed in 1967 to operate along the south and southeast. Aragão, "Fishing for tuna and similar fish in Brazil," *op. cit.*, p. 26. One report indicates longliners were acquired in 1969. Zavala-Camin and Antero da Silva, "Histórico da pesquisda ...," *op. cit.*, pp. 107-108.

350. SUDEPE, "National report of Brazil," 1986-87 *op. cit.*, p. 254.

351. Zavala Camin, "Ocorréncia de pixes ...," *op. cit.*

352. SUDEPE, "National report of Brazil," 1986-87 *op. cit.*, p. 254.

353. Aragao and Lima, "Análise comparativa ...," *op. cit.*, pp. 185-293.

354.The fishery is described in C.A. Arfelli and A.F. Amorin, "Description of the Brazilian swordfish fishery in Santos," ICCAT SCRS, 87/83, pp. 315-317

355. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183. An excellent review of the white marlin fishery is available in J.N.A. da Silva, A.F. Amorim, R.P.T. Lessa, F.H.V. Hazin, and C.A. Arfelli, "White marlin (*Tetrapturnus albidus*) fisheries off Brazilian coast from national and leased longliners fleet," *ICCAT Collective Volume of Scientific Papers*, Vol. XLI Report of the Second ICCAT Billfish Workshop (ICCAT: Madrid, 1994), pp. 189-198. Another excellent review is available on the sailfish fishery. F.H.V. Hazin, R.P.T. Lessa, A.F. Amorim, C.A. Arfelli, J.N. Antero-Silva," Sailfish (*Istiophorus platyptenus*) fisheries off Brazilian coast by national and leased longliners (1971-91)," *ICCAT Collective Volume of Scientific Papers*, Vol. XLI Report of the Second ICCAT Billfish Workshop (ICCAT: Madrid, 1994), pp. 199-213.

356. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183.

357. Amorim and Arfelli, "Estudo biológico ...," *op. cit.*

358. R. Cavalcante Ribeiro, "National Report of Brazil," *ICCAT Report*, 1982-83 (ICCAT: Madrid, 1983), pp. 224-227.

359. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183.

360. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 231.

361. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 407.

362. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 232.

363. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 183.

364. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 184.

365. Armando Duarte da'Silva, Manager of Rio Grande Plant, Leal Santos, personal communications, April 17, 1996. For details on the Japanese distant-water operations, see "International: B. Joint Ventures" below and Wildman, "Japan" *op. cit.*

366. ICCAT, "Report of the meeting of the infractions committee," *ICCAT Report* Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), p. 122.

367. Dias Neto, *et. al.*, "Technical considerations ...," p. 4.

368. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (I), p. 138.

369. A. F. Amorim, *et. al.*, "The evolution of tuna fishery in Santos-São Paulo, southern Brazil (1971-95), *ICCAT Col. Vol. Sci. Pap.*, 1996 (in press).

370. The Spanish have primarily been working with Cabedelo de Pesca and this company has not obtained an exemption from FDA to the automatic detention requirement nor have they appeared on the FDA list of companies shipping swordfish to the United States (appendices F2a-b).

371. Arfelli, *op. cit.*, November 14, 1998. The authors received lower 1997 estimates from some sources, but Dr. Arfelli's estimates are roughly corroborated by ICCAT SCRS data.

372. ICCAT-SCRS, "1998 swordfish detailed report," *1998 SCRS Report* October 17, 1998, p. 1.

373. ICCAT-SCRS, "1998 swordfish detailed report," *1998 SCRS Report* October 17, 1998, p. 1.

374. Dr. Hazin mentions that the monofilament gear is even being used by artisanal fishermen. Although their small vessels have a limited range, they are experiencing some success in coastal waters. F. Hazin, *op. cit.*, January 6, 1999.

375. Arfelli, *op. cit.*, November 14, 1998 and Maurizio Perotti, FAO, personal communications, November 16, 1998.

376. F. Hazin, *op. cit.*, April 21, 1998.

SECTION VIII. (Ports)

377. F. Hazin, *op. cit.*, July 17, 1996.

378. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (I), p. 138.

379. Da Silva Souza, op. cit., August 28, 1998.

380. Vooren, *op. cit.*, April 18, 1996.

381.Amorim, op. cit., August 24,1998.

382. Kotas, Azevedo, and dos Santos, *op. cit.*, February 1, 1999.

383. Silva *et. al.*, "White marlin ...," *op. cit.*, p. 190.

384. Wagner Oliveira Simões, ITS Fish, personal communications, August 24, 1998.

385. For details see M.P. Paiva, "Datos recientes sobre la investigación y la pesquería de tunidos y especies afines en Brazil," ICCAT Informe, 1974-75, Part 1 (ICCAT Madrid, 1975), pp.167-71.

386. Barros, "Algunos aspectos ...," pp. 12-32.

387. Hazin, *op. cit.*, July 17, 1996.

388. F. Hazin, *op. cit.*, August 26, 1998.

389. Gongalves Ferreirinha, *op. cit.*, April 17, 1996.

390. Two companies have deployed domestic longliners from Rio Grande. One domestic longliner began operations from Rio Grande in 1982 and a second in 1983, and they continued operations through 1987. The vessels were 28 m and 31 m; the smaller was equipped with a freezer while the larger had an ice hold. Silva, *et. al.*, "White marlin ...," *op. cit.*, p. 190 and J. Nelson Antero Silva, "Atunes e afins," *Coleção Meio Ambiente: Série Estudios--Pesca*, Nº 3 (IBAMA: Brasília, 1992), 31p.

391. Antero Silva, "Atuns e afins," *op. cit.*, pp. 17-18.

392. Urbano de Aranjo Neto, *op. cit.*, April 19, 1996.

393. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 125.

394. Aragão and Lima, "Análise comparativa ...," *op. cit.*

395. Arfelli, *op. cit.*, July 16, 1996.

396. Paiva, "Datos recientes...," *op. cit.*

397. Arfelli and Amorim, "Description of the Brazilian swordfish fishery ...," *op. cit.* and Zavala-Camin," Ocorrência de pixes ...," *op. cit.*

398. Zavala-Camin, "Histórico da pesquisa ...," *op. cit.*, p. 108.

399. Meneses de Lima, "National report of Brazil - 1991," *op. cit.*, p. 250.

400. Amorim, *op. cit.*, August 24, 1998.

401. Dottore, "O milagre ...," *op. cit.*

SECTION IX. (Transshipments)

402. Enrique Pereira, Manager, Belnova (Uruguayan-Spanish joint venture), personal communications, October 26, 1995.

403. Brazilian naval sources deny the charges. Capitão de Fragata, José Eduardo Gongalves Ferreirinha, Capitania dos Portos do Rio Grande do Sul, personal communications, April 17, 1996. The Brazilian company representatives the author spoke with in Rio Grande and Santos also deny such charges. One researcher in the northern port of Recife also indicates that there is no transshipping activity through Brazilian ports. Hazin, *op. cit.*, July 17, 1996.

404. Antero da Silva, *op. cit.*, April 17, 1996.

SECTION X. (Processing and Products)

405. F. Hazin, *op. cit.*, August 28, 1998.

406. Antero da Silva, *op. cit.*, April 17, 1996.

407. Elias Yemal, owner, Comércio de Pescados Caiçara, personal communications, April 20, 1996.

408. Imai, *op. cit.*, August 24, 1998.

409. The domestic fishermen retain almost all of the shark carcasses for sale in the local market, in contrast to the foreign leased fishermen who often discard the carcasses after finning. Jorge Eduardo Kotas, IBAMA/CEPSUL, personal communications, January 27, 1999. Shark fins have become quite valuable in recent years. U.S. fishermen, for example, report that prices have increased from about $35 per kg in 1991 to around $65 per kg in 1998. "Demand for Pacific shark increases," *Forum Fisheries Agency*, March-June 1998.

410. Many economists believe that the Brazilian real in 1998 was badly over-valued. This is one factor in the country's financial crisis which has necessitated a major International Monetary Fund rescue package. The over-valuation adversely affected companies which export because the actual value of earnings when converted into reales (the Brazilian currency) is less than comparable companies would realize in Chile, Costa Rica, Uruguay, Mexico, Venezuela, and other Latin American countries exporting swordfish. The problem is especially severe in Brazil because the country's swordfish shipments already sell at a substantial discount to product from other Latin American exporters (appendices G2e1-2). The Government's decision in January 1999 to devalue and then float the real and the currency's sharp decline will fundamentally change the economics of exporting in Brazil.

411. Yemal, *op. cit.*, April 20, 1996.

412. Imaipesca price list, April 19, 1996.

413. Imai, *op. cit.*, April 19, 1996.

414. F. H. Hazin, *op. cit.*, August 28, 1998.

415. R. Hazin, *op. cit.*, August 26, 1998.

416. NMFS plans to begin collecting actual price data on swordfish imports. The data will be based on actual invoices and thus offer more reliable data than the "apparent" price data used in this report. The data is being collected as part of an assessment of swordfish imports. NMFS is also considering regulations prohibiting the importation of swordfish smaller than those U.S. fishermen are allowed to retain. Christopher Rogers, NMFS, personal communications, January 5, 1999.

417. R. Hazin, *op. cit.*, August 26 , 1998.

418. Even a few bad shipments from Brazilian companies can affect the price that other companies receive.

419. M.R. Raghunath, "Myosin: The muscle protein we eat," *The Hindu*, August 7, 1997, available at http://www.hinduonline.com/daily/970807/08/08070002.htm,
retrieved November 29, 1998.

420. F. H. Hazin, *op. cit.*, August 26, 1998; R. Imai, *op. cit.*, August 24, 1998; A. Arvonovski, *op. cit.*, August 24. 1998; G. Johnson, *op. cit.*, October 15, 1997; and P. DuPuy, *op. cit.*, September 18, 1998.

421. Mejuto, De la Serna and Garcia, "Some considerations...," *op. cit.*

422. Ron Rinaldo, NMFS, personal communications, December 17, 1998 and Christopher Rogers, NMFS, personal communications, January 5, 1999.

423. An excellent brief review of temperature regulation and muscle structure in aquatic animals is available in Knut Schmidt-Nielsen, *Animal Physiology: Adaptation and Environment* (Cambridge University Press: New York, 1997), pp.284-287. Other helpful basic information is available in Raghunath, "Myosin ...," *op. cit.*

424. R. Hazin, *op. cit.*, August 26, 1998.

425. Imai, *op. cit.*, August 24, 1996.

426. Imai, *op. cit.*, August 24, 1998.

427. Oliveira Simões, *op. cit.*, August 24, 1998.

428. Imai, *op. cit.*, August 24, 1998.

429. In this regard the Brazilian fishermen are not unlike some U.S. fishermen who have the same view on the bloodline issue. Travis, *op. cit.*, December 8, 1998.

430. Imai, *op. cit.*, August 24, 1998.

431. F. H. Hazin, *op. cit.*, August 26, 1998.

SECTION XI. (Organizations)

432. Imai, *op. cit.*, August 24, 1998 and F. H. Hazin, *op. cit.*, August 26, 1998.

433. "Scallops e atum, nova opções da pesca", *Revista Nacional de Pesca*, February-March, 1975, pp. 5-6.

434. The company had previously acquired the vessel *Solano Star* after it was seized by the Federal Police as it was involved in a smuggling operation. "A tragédia de 'Tunamar'," *Pesca e Mar*, September-October, 1994, p. 4.

435. Aragão, "A pesca de atuns e afins no Brasil," *op. cit.*, p. 28

436. Elias Yemal, Comércio de Pescados Caiçara, personal communications, April 20, 1996.

437. "Scallops e atum ..., *op. cit.*, pp. 5-6.

438. INFOPESCA, " Nuevo atunero ...," *op. cit.*

439. Aragão, "A pesca de atuns e afins no Brasil," *op. cit.*, p. 28

440. For details on these vessels and the Barbados company which owns them, see the Barbados chapter of this study.

441. Imai, *op. cit.*, April 19, 1996.

442. Imai, *op. cit.*, April 19, 1996.

443. Oliveira Simões, *op. cit.*, August 24, 1998.

444. At the time the authors visited Santos (April 19, 1996), the *Julius*, which had recently arrived, was laid up for engine repairs. The necessary part was not available locally.

445. Oswaldo Shoiti Babá, Kawai Suisan, personal communications, April 19, 1996.

446. Shoiti Babá, *op. cit.*, April 19, 1996.

447. Nelson Gomez, fisherman, personal communications, April 19, 1996.

448. Demétrio Urbano de Araújo Neto, Director Social, Sindicato do Pescadores e Trabalhadores Assemlhados do Estado de São Paulo, personal communications, April 19, 1996.

449. Shoiti Babá, *op. cit.*, April 19, 1996.

450. Silvia Fantinnatti, "A tecnologia incrementa as exportações de atum, *Gazeta Mercantil*, September 28, 1987.

451. Armando Duarte da'Silva, President, Leal Santos, personal communications, April 17, 1996.

452. The authors note that the arrangements for the leases are generally quite informal, often with no formal contracts. Thus the Asian companies operating the vessels are sometimes reluctant to deal with new companies or owners.

453. Carolus Maria Vooren, FURG, personal communications, April 18, 1996.

454. F. H. Hazin, *op. cit.*, August 27,1998.

455. R. Hazin, *op. cit.*, August 27, 1998.

456. F. H. Hazin, *op. cit.*, August 26, 1998.

457. R. Hazin, *op. cit.*, August 26, 1998.

458. R. Hazin, *op. cit.*, August 26, 1998.

459. Miami is the most important U.S. airport handling shipments of fresh seafood and in 1996 was conducting a massive, $500-million project to expand its cargo infrastructure, in part to handle the booming seafood traffic. Shipment patterns are constantly changing. One report indicated in mid-1996 that major Brazilian purchases of computers and other products was causing much greater southerly traffic and thus some good rates available on northerly shipments. Rob Lovitt, "Flying high," *Seafood Leader*, July/August, 1996, pp. 76-80.

460. F. Hazin, *op. cit.*, July 17, 1996.

461. F. Hazin, *op. cit.*, February 11, 1998.

462. Aragão, "A pesca de atuns e afins no Brasil," *op. cit.*, p. 28

463. A variety of factors could have been involved: fish prices, fuel prices, other access opportunities, etc. Hermann Werner Hadrich, Director, Pescal, personal communications, April 17, 1996.

464. Hadrich, *op. cit.*, April 17, 1996. The authors note that the vessels leased in 1979-80 were not reported in the detailed records kept by CEPERG/IBAMA, but the ones leased subsequently in 1992-93 were noted (appendices A2c3-4).

465. As with the arrangements negotiated by several other Brazilian companies, no formal contracts were signed. The arrangements were sealed by a hand shake. Hadrich, *op. cit.*, April 17, 1996.

466. A variety of factors could have been involved: fish prices, fuel prices, other access opportunities, etc. Hermann Werner Hadrich, Director, Pescal, personal communications, April 17, 1996.

467. INFOPESCA, "Grave crisis lleva a pérdida de puestos de trabajo," *Noticias Comerciales*, December 5, 1998.

468. "Atum en alta," *Pesca e Mar*, November-December, 1992, p. 8.

469. Imai, *op. cit.*, April 19, 1996.

470. Antero Silva, *op. cit.*, June 27, 1996.

471. Antonio B. Anderson Elles, President, and Carlos Roberto Silva Medeiros, Treasurer, Sindicato dos Pescadores de Rio Grande, personal communications, April 17, 1996.

472. Demétrio U. de Araújo Neto, Director Social, SINPESCATRAESP, Santos, April 19, 1996.

SECTION XII. (Markets)

473. European exporters have begun to take increasing interest in the Brazilian market. The Federation of Norwegian Dried Salted Codfish and Saltfish Exporters (Unidos), for example, has initiated a marketing campaign in Brazil to establish brand identification and expanded sales. "Saltfish sets new sales records for Norway," *Seafood International*, November 1998, p. 25.

474. Hadrich, *op. cit.*, April 17, 1996.

475. Part of the destruction of the native population was in part violence and brutality exhibited by the conquering Portuguese, but the goal was not to exterminate the natives. Actually the Portuguese desired to exploit the natives as the labor force in the new colony. This was to prove impossible because of the rapid decline in the native population. As elsewhere in the Americas, including the United States, a large--if not the largest--cause of native death was the unintentional introduction of European diseases to which the native population had no natural immunity.

476. Imai, *op. cit.*, April 19, 1996.

477. INFOPESCA recently published an excellent survey of the Rio market. Silvio Jablonski, Alex Schmitz du Mont, and Jean Sergio de Oliveira, "O mercado de pescados no Rio de Janeiro," *Serie o Mercados de Pescados nas Grandes Cidades Latino-Americanas*, Vol. 3 (INFOPESCA: Montevideo, Uruguay, October, 1997), 79p.

478. Hadrich, *op. cit.*, April 17, 1996.

479. Yemal, *op. cit.*, April 20, 1996.

480. Hadrich, *op. cit.*, April 17, 1996.

481. Jablonski, Schmitz du Mont, and Oliveira, "O mercado de pescados," *op. cit.*, p.23.

482. Jablonski, Schmitz du Mont, and Oliveira, "O mercado de pescados," *op. cit.*, p.23.

483. Amorim, *op. cit.*, April 20, 1996 and Hadrich, *op. cit.*, April 17, 1996.

484. Jablonski, Schmitz du Mont, and Oliveira, "O mercado de pescados," *op. cit.*, pp. 37-43

485. Hadrich, *op. cit.*, April 17, 1996.

486. Jablonski, Schmitz du Mont, and Oliveira, "O mercado de pescados," *op. cit.*, p.23.

487. Yemal, *op. cit.*, August 20, 1996. The store has since been sold and is now known as New Symbol Comercio Exportador.

488. Imai, *op. cit.*, April 17, 1996.

489. Shoiti Babá, *op. cit.*, April 19, 1996.

490. F. H. Hazin, *op. cit.* August 26, 1998.

491. R. Hazin, *op. cit.*, August 26, 1998.

492. F. Hazin, *op. cit.*, August 27, 1998.

493. Imai, *op. cit.*, August, 1998.

494. Imai, *op. cit.*, April 19, 1996.

495. Shoiti Babá, *op. cit.*, April 19, 1996.

496. The companies the authors spoke with during a 1996 visit to Brazil all insisted that most of the catch was being exported. Additional conversations in 1998 confirmed that Brazilian companies are mostly exporting their swordfish catch. Important companies like Imaipesca and Norte Pesca all insist that they are exporting almost all of their catch to the United States. Imai, op. cit., August 24, 1998 and F. H. Hazin op. cit. August 26, 1998. Brazilian scientists following the industry confirmed that this corresponds to information provided by other company representatives through 1997. Low international prices in 1998 caused several companies to seek alternate markets and they increased efforts to sell swordfish domestically. As a result, larger quantities may have been sold domestically in 1998 than had been the case in past years. The decline of the real in 1999 will cause companies to increase their focus on export sales.

497. Imai, *op. cit.*, April 19, 1996.

498. Yasunobu Matsuura, Instituto Oceanografico, Universidade de São Paulo, personal communications, January 11, 1999; Carolus Vooren, *et. al.*, "Analise de estatistica da pesca de elasmobranquios demersais no porto de Rio Grande, de 1973 a 1986," *Ciencia e Cultura*, Vol. 42, No. 12, 1990, pp. 1106-1114; and M. Haimovici, "Recursos pesqueiros demersais da regiao sul," *FEMAR*, Rio de Janeiro, pp. 1-76.

499. Jorge Eduardo Kotas, V.G. Azevedo, and S. dos Santos, CEPSUL/IBAMA, personal communications, February 1, 1999. These three CEPSUL researchers were kind enough to collaborate to answer questions posed by the authors.

500. One assessment done by an Itajaí company found they could sell blue shark domestically at $1.30-1.50/kg while they received about $3.00/kg for swordfish. Kotas, Azevedo, and dos Santos, *op. cit.*, February 1, 1999. Most of the shark catch is blue shark, but some species like makos could be sold at higher prices. Thus if they could catch more than twice as much fish by setting for shark, they could potentially earn more than by setting for swordfish.

501. Matsuura, *op. cit.*, January 11, 1999

502. The authors do not have Brazilian export data to confirm this. Uruguayan export data, however, shows minimal exports of oilfish to the United States. INAPE, *Informe Sectorial Pesquero*, 1997 (INAPE: Montevideo, 1998), pp. 29, 32. The same pattern is probably true for Brazil.

503. *Gazeta Mercantil* as cited in INFOPESCA, "Grandes empresas ingresan al negocio pesquero," *Noticias Comerciales*, December 20, 1998.

504. Several Brazilian industry representatives were more skeptical about available foreign trade data suggesting imports were only a fraction of the catch. Swordfish might be difficult for U.S. Custom agents to identify in trunk form, without the distinctive head, some knowledge of fish species would be needed. In addition, the FDA regulations requiring automatic detention, provide some incentive for mislabeling. The size of the statistical discrepancies, however, seem unusual. In addition, such large statistical anomalies are not as consistently reported as is the case for Brazilian swordfish.

505. Since these are the important world markets for swordfish, an analysis of their import data provide a good rough estimate for Brazilian export patterns and trends. In recent years most of the shipments have been to the United States. Brazil may have shipped small quantities of swordfish to other countries, but any such shipments are believed to have been minor and will not significantly impact overall Brazilian swordfish trade patterns.

506. Imai, *op. cit.*, August 24, 1998 and F. H. Hazin, *op. cit.*, August 26, 1998.

507. Amorim, *op. cit.*, August 24,1998; Imai, *op. cit.*, August 24, 1998; and R. Hazin, *op. cit.*, August 26, 1998.

508. The U.S. environmental groups SeaWeb and the Natural Resources Defence Council helped organize the "Give Swordfish a Break" campaign in the United States. The organizers after the first year have declared the campaign successful. Fishing industry groups claim the campaign isn't helping conservation, but is hurting fishermen. "Advocates claim victory in boycott of swordfish," *National Fishermen*, January 1999, pp. 11-12.

509. Brazilian sources indicate that such price data must be treated with caution as much fish is imported on consignment and the final sale price may be different than the preliminary invoice price. F. H. Hazin, *op. cit.*, August 26, 1998.

510. The one-third estimate is based on the relative composition of the catch and the fact that much of the available swordfish, but not the billfish, is exported to the United States. The authors would be especially interested in any information readers may have on the species composition of the billfish shipments to the United States. Japan refined the import categories in 1997 (appendix G32), but no historical data on the new frozen swordfish category is available.

511. See the various other chapters of this study for details on the export patterns of other Latin American countries.

512. See for example, Dennis Weidner, Tom Revord, Randy Wells, and Amir Manuar, "Brazil," *World Shrimp Culture*, Vol. II, part 3, NOAA Tech. Memo NMFS-F/SPO-7 (NMFS: Silver Spring, Maryland, September 1992).

513. Imai, *op. cit.*, April 19, 1996.

514. Jack Chen, Specialist, Taipei Trade and Cultural Representative Office, personal communications, April 24, 1998.

515. Taiwan Fisheries Bureau, Fisheries Yearbook Area (Taiwan Fisheries Bureau: Taipei, June, 1997), p. 185.

516. Antõnio Costa Filho, "O atum exportado por caminhão," *Gazeta Mercantil*, May 16, 1986.

517. Source: INAPE, *Informe Sectorial Pesquero*, 1997, pp. 24-37.

518. Thome, *op. cit.*, January 26, 1999.

SECTION XIII. (Government Policy)

519. Detailed but now dated summaries of Brazilian fisheries legislation are available in SUDEPE, *Legislação Pesqueira: Textos Básicos* (SUDEPE: Brasília, 1981), 95p; SUDEPE, *Coletãnea de Documentos Legais da SUDEPE* (SUDEPE: Brasília, 1981), 59p; and Ademir Eugênio Lopes, editor, Vo. I-III *Legislação Basíca da Pesca* (Waldeck: Niteró, 1976).

520. ICCAT, "Report of the meeting of the Infractions Committee," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 80.

521. ICCAT, "Report of the meeting of the infractions committee," *ICCAT Report* Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), p. 122.

522. Foscolos, *op. cit.*, April 19, 1996.

523. Law No. 8617, January 4, 1993.

524. IBAMA, "The allocation of catch for south Atlantic swordfish: The Brazilian approach," Brasilia, July 1997, document presented at the ICCAT inter-sessional meeting of panel 4.

525. The different alternative quota allocations devised by the Brazilians were presented at a July 1997 ICCAT inter-sessional meeting in Brazil. Dias *et. al.*, "Technical considerations ...," *op. cit.*, tables 5-7.

526. "Statement by Brazil in relation to the allocation of catch quota for south Atlantic swordfish," Report of informal inter-sessional meeting of panel 4, João Pessoa, Brazil, July 15-16, 1997.

527. IBAMA, "The allocation of catch ...," *op. cit.*

528. IBAMA, "The allocation of catch ...," *op. cit.*

529. Portaria 115 issued August 17, 1998.

530. IBAMA, "The allocation of catch ...," *op. cit.*

531. U.S. Embassy, Brasilia, March 3, 1989.

532. See, for example, "A vista de González," *Tempo de Pescar*, July 1987; "Italianos querem pescar no litoral NE do Brasil," *Revista Nacional de Pesca*, November, 1976; U.S. Embassy, Brasilia, May 14 and July 2, 1981, April 30, 1982, and October 1, 1985; U.S. Embassy, Seoul, August 4, 1976; "Fishery pacts," Haptong, Seoul radio broadcast, 0253 GMT, February 13, 1978; "Brazil fishing station urged by lawmakers," *Korea Herald*, August 4, 1977; "Kim Chong-Pil to visit L.A., Africa, ROC, as Pak's envoy," Haptong, Seoul radio broadcast, 0320 GMT, February 7, 1977; "Fishing treaty negotiations," AFP, Rio de Janeiro radio broadcast, 1735 GMT, July 27, 1971; "Missão chinesa," *Revista Nacional de Pesca*, December 1970; "O ministro e conselheiro economico," *Boletim Mercado Pesquiero*, March 1973; Dennis Weidner, "United States-Brazil fishery negotiations," *International Fishery Reports*, (IFR-78/49), March 15, 1978; "Relations with PRC, Soviet Union evaluated," *Jornal do Brasil*, July 17, 1988, p. 27; "Polonia quer investir na indústria da pesca," *Revista Nacional de Pesca*, December, 1975; "Os portugueses está vindo para pescar," *Revista Nacional da Pesca*, June 1975; Brésil: Négocations avec l'Espagne," *La Pêche Maritime*, December 20, 1984.

533. For details see the Brazilian chapter in Weidner and Hall, "Latin America," *op. cit.*

534. Portaria N°19, October 29, 1976.

535. SUDEPE, "National report of Brazil," 1986-87 *op. cit*, p. 255.

536. F. Hazin, *op. cit.*, August 26, 1998.

537. Details on the Japanese distant-water longline fleet and operations are available in Mark Wildman, "Asia," *World Fishing Fleets*, Vol. III (NMFS: Silver Spring, Maryland, November 1993), pp. 26-45 and Mark Wildman, "Asia," *World Swordfish Fisheries*, Vol. III (NMFS: Silver Spring, Maryland, November 1993), pp. 26-77.

538. Charles Peckham, "Tuna in trade," *Seafood International*, November, 1998, p. 41.

539. G. Sarró Iparraguirre, Organización de Productores Asociados de Grandes Atuneros Congeladores (OPAGAC), personal communications, March 25, 1998.

540. José Echeandía Zegarra, General Manager, TRAMARSA, personal communications, June 26, 1996 and J.P. Rodriguez-Sahagún, Asociación Nacional de Armadores de Buques Atuneros Congeladores (ANABAC), personal communications, March 25, 1998. For details on Peruvian Pacific longline operations, see the Peruvian chapter of this study.

541. See the Uruguayan chapter of this report for details.

542. Da Silva Souza, *op. cit.*, August 28, 1998.

543. Portaria N°19, October 29, 1976. For detail on SUDEPE's efforts see "Atum: avanço brasileiro na pesca oceânica," *Revista Nacional da Pesca*, No. 160, November, 1976, pp.18-20.

544. De Kanel, "SUDEPE fosters ...," *op. cit.*, p. 1.

SECTION XIV. (Research)

545. Basil de Kanel, "SUDEPE fosters fishing to feed hungry humanity," *Brazil Herald*, March 13, 1980, p. 1.

546. Cavalcante Ribeiro, "National report ...," *op. cit.*, p. 225.

547. "Science and technological development threatened," *Nature*, 395, 831 (1998).

548. "Plan to build rockets, satellites being drafted with Brazil," Madrid EFE, 1429 GMT, March 10, 1997.

549. See the Chilean chapter of this study for details.

550. See for example Antero Da Silva, Antero and J. Nelson. "Tuna fishery in Brazil ...," *op. cit.*; J.N. Antero Da Silva, and J. Nelson. *Perfil Pesqueiro ...*" *op. cit.*; and J.N. Antero Da Silva, "Acompanhamento da pesca ...," *op. cit.*

551. Jorge Eduardo Kotas, CEPSUL/IBAMA, personal communications, January 27, 1999.

552. Castello, *op. cit.*, April 18, 1996.

553. Vooren, *op. cit.*, April 18, 1996.

554. See for example, Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, and Castello, "Analise de conteudos ...," *op. cit.*

555. Vooren, *op. cit.*, April 18, 1996.

556. The researcher is Carlos Alberto Garcia in the FURG Department of Physical Oceanography.

557. Moisés Conceição, Laboratorio de Bioquímica Marinha, FURG, personal communications, April 18, 1996.

558. Dr. José A Levy, Laboratorio de Bioquímica Marinha, FURG, personal communications, April 18, 1996.

559. Levy, *op. cit.,* January 25, 1999.

560. Tatiana Neves, FURG, personal communications, April 1, 1998.

561. See for example Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 232 and Antero-Silva, "Desempenho ...," *op. cit.*

562. Meneses de Lima, "National report of Brazil," 1984-85, *op. cit.*, p. 232.

563. Meneses de Lima, "National report of Brazil," 1990-91, *op. cit.*, p. 408.

564. Foscolos, *op. cit.*, April 19, 1996.

565. ICCAT, "Bi-annual highlights report: ICCAT Enhanced Research Program for Billfish," 1-7/95, p. 2.

566. ICCAT, "Bi-annual highlights report ..." 1-7/95, *op. cit.*, p. 2.

567. Prince, *op. cit.*, November 24, 1998.

568. Thomé, *op. cit.*, January 20, 1998.

569. Thome, *op. cit.*, January 26, 1999.

570. In Brazil the term "Ministry" is reserved for Federal departments. Such as Brazil's Federal Ministry of Agriculture. Comparable state agencies are "Secretariats," such as the São Paulo state Secretariat of Agriculture which is the parent agency of the IP.

571. Formerly the Divisão de Pesca Maritima.

572. Jose Alfredo P. Coelho, Deputy Director, Instituto de Pesca, April 19, 1996.

573. ICCAT, "Bi-annual highlights report ..." 1-7/95, *op. cit.*, p. 2.

574. Arfelli, *op. cit.*, January 20, 1999.

575. ICCAT, "Program plan for the ICCAT enhanced research program for billfish - 1992," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 244.

576. Amorim, *op. cit.*, April 20, 1996.

577. "Captura de meca marcada há 11 anos ajuda projeto do Instituto de Pesca," *A Tribuna*, November 6, 1993, p. A10.

578. Pratt, *op. cit.*, October 27, 1998 and Arfelli, *op. cit.*, August 24, 1998.

579. Secchi, *op. cit.*, March 19, 1998.

580. P.C. Scott, "Fish aggregating buoys in Brazil," *ICLARM Newsletter*, April, 1985, p. 11.

581. Melquíades Pinto Paiva (coordinator), *Recursos Pesqueiros Estarinos e Marinhos do Brasil* (Fortaleza: UFC Edições, 1997).

582. See for example Pinto Paiva and de Andrade-Tubino, "Proução, esforço ...," *op. cit.* Dr. Pinto Pavia has published numerous studies on tuna and the tuna fishery, but he is currently working with the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and not with UFRJ.

583. Meneses de Lima, "National ..." *op. cit*, 1992, pp. 334-335.

584. UFRPe held the first REVIZEE workshop during August 1996. Hazin, *op. cit.*, July 31, 1996.

585. F. Hazin, *op. cit.*, February 11, 1998.

586. F. H. Hazin, *op. cit.*, August 26, 1998.

587. Alexandre Zerbini, Dep. de Zoologia, Instituto de Biociencias, Universidade de São Paulo, personal communications, March 26, 1998.

588. Dr. Yasunobu Matsuura has published several valuable studies on sharks and the shark fishery.

589. Arfelli, *op. cit.*, April 19, 1996.

590. ICCAT, "Report of the Standing Committee on Research and Statistics," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), p. 104 and Meneses de Lima, "National ..." *op. cit*, 1984-85, pp. 232-233.

591. Meneses de Lima, "National report of Brazil," 1990-91, *op. cit.*, p. 408.

592. Amorim, *op. cit.*, April 24, 1996.

593. ICCAT, "Program plan for the ICCAT enhanced research program for billfish - 1992," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 243 and O. Mora, "National report of Uruguay," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 291.

594. Lee, "Report to the Government ...," *op. cit.*

595. SUDEPE, "National report of Brazil," 1986-87 *op. cit*, p. 255.

596. Arfelli, *op. cit.*, January 20, 1999.

597. ICCAT, "1999 program plan for the ICCAT Enhanced Program for Billfish," doc no. 008, November 28, 1998.

SECTION XV. (Bycatch)

598. Zerbini, *op. cit.*, March 26, 1998.

599. Joca Thomé, Regional Coordinator, Project TAMAR-IBAMA, personal communications, January 20, 1999.

600. Eric Prince, NMFS, personal communications, November 16, 1998.

601. The Brazilian Government's future research policies are difficult to assess at the time this report was finalized in January 1999. Not only has the new Department of Fisheries no yet decided on major research programs, but a new head of IBAMA has been appointed, further complicating future policy initiatives. All of this is over shadowed by the ongoing financial crisis in Brazil which led to a devaluation of the real and almost certainly will lead to further major reductions in government spending. Almost certainly research funding will be affected.

602. BirdLife, *Global Impacts of Fisheries on Seabirds: A paper presented by BirdLife: International for the London Workshop on Environmental Science, Comprehensiveness and Consistency in Global Decisions on Ocean Issues* ED/kc(aquaunit/EDGLOBAL/1853(w6), November 1995, p. 4.

603. International Coalition of Fishing Associations, "Longline fishing meets the challenge," brochure published in 1999.

604. C.A. Arfelli, A.F. Amorim, and R. Graca-Lopes, "Billfish sport fishery off Brazilian coast" SCRS/92/54 *Collective Volume of Scientific Papers* Vol. XLI (ICCAT: Madrid, Spain, 1994), pp. 214-217 and E.G. Pimenta, F.R. Marques, J.C. Cordeiro, and J. Guilherme, "Billfish tournament off Cabo Frio - Rio de Janeiro, Brazil," SCRS/96/105 *Collective Volume of Scientific Papers* Vol. XLVII (ICCAT: Madrid, Spain, 1998), pp. 185-186.

605. ICCAT, *Statistical Bulletin*, 1996 (ICCAT: Madrid, Spain, 1998), p. 218.

606. F.H.V. Hazin, R.P.T.Lessa, A.F. Amorim, C.A. Arfelli, "Sailfish (*Istiophorus platypterus*) fisheries off Brazilian coast by national and leased longliners (1971-91)," SCRS/92/52 *Collective Volume of Scientific Papers* Vol. XLI (ICCAT: Madrid, Spain, 1994), pp. 199-207.

607. Some authors refer to black marlin off Brazil, probably because one of the Brazilian terms for blue marlin is black marlin, as suggested by the scientific name. In addition, blue marlin is referred to as black marlin (marlín negro) by CARPAS and in some Spanish-speaking Atlantic-coast countries such as Argentina.

608. A.F. Amorim, C.A. Arfelli, F.H.V. Hazin, J.N. Antero-Silva, R. Lessa, and R.R. Arraes "Blue marlin (*Makaira nigricans*) fisheries off Brazilian coast by national and leased longliners (1971-91)," SCRS/92/53 *Collective Volume of Scientific Papers* Vol. XLI (ICCAT: Madrid, Spain, 1994), pp. 199-207.

609. A.F. Amorim, C.A. Arfelli, J.N. Antero-Silva, L. Fagundes, F.E.S. Costa, R. Assumpção, "Blue marlin (*Makaira nigricans*) and white marlin (*Tetrapturus albidus*) caught off the Brazilian coast," SCRS/96/101 *Collective Volume of Scientific Papers* Vol. XLVII (ICCAT: Madrid, Spain, 1998), pp. 199-207 and Amorim, *et. al.*, "Blue marlin ...," *op. cit.*, p. 170.

610. ICCAT, "SCRS figures," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 267.

611. ICCAT statistical data, *Statistical Bulletin*, 1996 (ICCAT: Madrid, Spain, 1998), p. 220.

612. ICCAT, "SCRS figures," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 267.

613. J.N.A. da Silva, A.F. Amorim, R.P.T. Lessa, F.H.V. Hazin, and C.A. Arfelli, "White marlin (*Tetrapturus albidus*) fisheries off Brazilian coast by national and leased longliners fleet," SCRS/92/51 *Collective Volume of Scientific Papers* Vol. XLI (ICCAT: Madrid, Spain, 1994), pp. 199-207 and Amorim, *et. al.*, "Blue marlin ...," *op. cit.*, pp. 165-167.

614. ICCAT, "SCRS figures," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 271.

615. Amorim, *et. al.*, "Blue marlin ...," p. 166-168.

616. ICCAT, "SCRS figures," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 271.

617. The CPUE pattern is very similar if calculated by number of fish instead of weight. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 130.

618. Matsuura, *op. cit.*, January 11, 1999 and Vooren *et. al.*, "Analise de estadistica ...," *op. cit.*

619. Kotas, *op. cit.*, January 27, 1999.

620. F. Hazin, *op. cit.*, August 26, 1998.

621. Meneses de Lima, "National ..." *op. cit*, 1992, pp. 334-335.

622. F.H.V. Hazin, A.A. Couto, K. Kihara, K. Otsuka, and M. Ishino, "Distribution and abundance of pelagic sharks in the southwestern equatorial Atlantic," *J. Tokyo Univ. Fish.*, Vol. 77, No. 1, 1990, pp. 51-64.

623. Kotas, *op. cit.*, January 27, 1999.

624. Olmos, *op. cit.*, January 14, 1999.

625. The authors reported that grey sharks were particularly abundant on undersea submits. Hazin, Zagageliz, Broadhurst, Trauzssos, and Bezerra, "Review of a small-pelagic longline fishery off northeastern Brazil," *op.cit.*

626. U.S. fishermen normally retain only makos, threshers, and a few other species. Sharks such as blues and white tips are normally discarded after finning. "Demand for Pacific shark increases," *Forum Fisheries Agency News Digest*, March-June, 1998.

627. Meneses de Lima, "National ..." *op. cit*, 1992, pp. 335.

628. P. Prince, personal communications, as cited in BirdLife, *Global Impacts of Fisheries on Seabirds: A paper presented by BirdLife: International for the London Workshop on Environmental Science, Comprehensiveness and Consistency in Global Decisions on Ocean Issues* ED/kc(aquaunit/EDGLOBAL/1853(w6), November 1995, p. 8.

629. Olmos, *op. cit.*, January 14, 1999.

630. Arturo, *op. cit.*, January 12, 1999.

631. All the catch is marketed domestically. This would be about half of the price received for swordfish in 1998. Kotas, Azevedo, and dos Santos, *op. cit.* February 1, 1999.

632. The CPUE pattern is very similar if calculated by number of fish instead of weight. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 130.

633. Hong, *op. cit.*, July 16, 1996.

634. A.F. Amorim, "Estudo da biologia da pesca e reprouçio do cação azul *Prionace glauca* I. 1758, capturado no sudeste e sul do Brasil," Ph.D Thesis, Instituto de Biociências, Universidade Estadual Paulista, 1992, 205p.

635. Kotas, Azevedo, and dos Santos, *op. cit.*, February 1, 1999.

636. Amorim, "Estudo da biologia ...," *op. cit.*

637. Kotas, Azevedo, and dos Santos, *op. cit.*, February 1, 1999.

638. Amorim, "Estudo da biologia ...," *op. cit.*

639. These concerns are summarized from NMFS and State Department conversations with various Brazilian officials and industry representatives. They are essentially the same arguments made by each country in the initial phases of considering the implementation of a TED program. The author spoke to a group of Brazilian environmental/fisheries enforcement trainees with the Polícia Florestal/Fiscalização Marítima trainees. Their instructors raised many of these same concerns.

640. Some information on the distribution of sea turtles off Brazil is available in M.A. Marcovaldi, "Sea turtle conservation program in Brazil expands activities," *Marine Turtle Newsletter*, Number 52, pp. 2-3 and M.A. Marcovaldi and G.G. Dei. Marcovaldi, "Projeto Tartaruga Marinha: Areas de desova, época de reprodução, técnicas de preservação," *Boletim Fundação Brasileira para Conservação da Natureza*, Vol. 22, pp.95-104.

641. Kotas, *op. cit.,*, January 27, 1999.

642. Lori Lee Lum, Eduardo Moreira Lima, and Alexsandro Santos, "Green turtle tagged in Brazil recovered in Trinidad," *Marine Turtle Newsletter*, October,. 1998, p. 9; Eduardo H.M.S. Lima, TAMAR, personal communications, February 24, 1999; J.P. Schulz, "Sea turtles nesting in Suriname," *Zool. Verh.* Leiden, 1975, Vol. 143, pp. 1-143; and A. Carr, "The Ascension Island Green Turtle Colony," *Copeia*, 1975, pp. 547-555.

643. Fundação Pró-TAMAR, *Manual das artes de pesca que capturan tartarugas marinhas no Brasi,* in preparation as of May 1998.

644. Neca Marcovaldi, President, Fundação TAMAR, personal communications, June 8, 1998.

645. Maria Angela Marcovaldi, *et. al.*, "Activities by project TAMAR in Brazilian sea turtle feeding grounds," *Marine Turtle Newsletter*, April, 1998, No. 80, pp. 5-7.

646. Maria Angela Marcovaldi, Augusto C.C.D. da Silva, Berenice M.G. Gallo, Cecilla Baptistotte, Claudia F. Vieitas, Claudio Bellini, Eduardo H.S.M. Lima, Jacqeline C. de Castihos, João C.A. Thomé, and Taisi M. Sanches, "Sea turtle feeding grounds of Brazil," paper delivered at the 18th International Symposium on Sea Turtle Biology and Conservation, Mazatlán, Sinaloa, Mexico, March 3-7, 1998.

647. Marcovaldi, *op. cit.*, June 8, 1998.

648. Marcovaldi, *et. al.*, "Activities by Project TAMAR ...," *op. cit.*, p. 5.

649. C.P.R. Barata, B.M.G. Gallo, S. dos Santos, V.G. Azevedo, and J.E. Kotas, "Captura incidental da tartaruga marinha *Caretta caretta* (Linneaus, 1758) na pesca de espinhel de superficie na ZEE brasilieira e em águas internacionais," *XI Semana Nacional de Oceanografia, Oceanografia e Suas Interfaces Resumos Expandidos* (Fundação Universidade do Rio Grande: Centro Acadêmico Livre de Oceanologia: Rio Grande, 1998).

650. Marcovaldi, *op. cit.*, June 8, 1998.

651. The researchers hope to submit the results to *The Turtle Newsletter* in early 1999. A compilation of the results may be ready for presentation at the 19th Sea Turtle Symposium scheduled for Texas in March 1999. Paulo Barata, TAMAR, personal communications, January 28, 1999.

652. Coelho, *op. cit.*, April 19, 1996.

653. Turtles were taken at depths ranging from 40-130 meters. Many were boated alive and released. Data since 1992 is, however, only available on seven interactions. Claudia Vieitas, Projecto TAMAR, personal communications, March 17, 1998.

654. An observer during 5 cruises (50 fishing days) reported only one loggerhead taken and it was boated dead. Olmos, *op. cit.*, March 12, 1998.

655. T. Vaske Jr., R.M. Mello, and J.P. Castello, "Relación de las especies capturadas por palangreros en el sur de Brasil," Resumenes de trabajos de investigación, Panel presentado en el Octavo Simposio Científico de la CTMFM, 1991.

656. Coelho, *op. cit.*, April 19, 1996.

657. The TAMAR researchers report, "We believe that the [turtle] mortality due to longline fishing is greater than the turtles brought aboard dead, due to careless handling by the fishermen [of the turtles which are still alive], wounds caused by the hooks and capture stress." Barata, *et. al.*, "Captura incidental ...," *op. cit.*

658. Juan A. Camiñas at the Centro Oceanográfico de Málaga of the Instituto Español de Oceanografía is one of the primary Spanish researchers working on turtles. Victor Alcalá Fernandez, Centro de Estudios Marinos Universitario, personal communications, July 9, 1998.

659. Enric Badosa i Malagelada, University of Barcelona, personal communications, July 9, 1998.

660. Luis Feipe Lopez Jurado, University of Las Palmas de Gran Canaria, personal communications, July 8, 1998.

661. Hong, *op. cit.*, July 16, 1996.

662. One Atlantic tuna/swordfish longline study noted 501 turtles taken in over 2,900 sets. Many were boated live and released. A substantial number of the turtles were still alive. Many of the turtle mortalities were taken in the warm core rings of the Gulf Stream. John Hovey, National Fisheries Institute, personal communications, February 24, 1998.

663. F. Achaval y Y. Marin, "La captura incidental de tortugas con palangre pelagico oceanico," in press, advanced copy supplied by authors April, 14, 1998.

664. See the Uruguayan chapter of this study for a more complete discussion of the turtle bycatch off Uruguay.

665. Amorim, *op. cit.*, April 20, 1996.

666. Some fishermen report occasional sightings of "bofos." Roberto Teixera Gomes, artisanal longline fisherman, São Gonçalo Amarante, Rio Grande do Norte, personal communications, August 27, 1998 and Thales Ramon de Quieroz Bezerra, Rio Grande do Norte, IBAMA official, personal communications, August 27, 1998.

667. U.S. sources confirm that similar interactions have been observed off the U.S. Atlantic coast. John Hoey, NMFS, personal communications, January 5, 1999.

668. Shoita Babá, *op. cit.*, April 19, 1996 and F.H. Hazin, *op. cit.*, August 26, 1998.

669. The entangled animals are the most likely to die. The smaller numbers of animals accidentally hooked, as long as the ganglions are reasonably long, should be able to reach the surface. Hoey, *op. cit.*, January 6, 1999.

670. Zerbini. *op. cit.*, March 26, 1998.

671. Amorim, *op. cit.*, April 20, 1996.

672. Fabio Olmos, Cooperação Tecnica PNUD, personal communication, March 12, 1998.

673. Zerbini, *op. cit.*, March 26, 1998.

674. One of the principal Spanish institutes working on marine mammals is the Centro de Estudios Marinos Univeritario. Alcalá Fernandez, *op.cit.*, July 9, 1998.

675. Badosa Malagelada, *op.cit.*, July 9, 1998.

676. Andre, *op.cit.*, July 8, 1998.

677. Hong, *op. cit.*, July 16, 1996.

678. For a fuller discussion see the Venezuela chapter of this report.

679. The Japanese use larger numbers of hooks and smaller distances between vertical hook lines. This would increase the possibility of accidental hookings and entanglement, especially if the whales are feeding on the catch. Also if fish are hooked on a Japanese line, the weight of the gear and catch (because of the more dense hook settings) would make it difficult for an entangled whale to reach the surface to breathe. Hoey, *op. cit.*, February 24, 1998.

680. Zerbini, *op. cit.*, March 26, 1998.

681. Randal Reeves, IUCN-Cetacean Specialist Group, Okapi Wildlife Associates, personal communications, January 7, 1999.

682. F. Hazin, *op.cit.*, August 26, 1998.

683. See the Uruguayan chapter of this report for details.

684. See the Uruguay chapter of this report for a more detailed description of pinniped interactions.

685. Amorim, *op. cit.*, April 19, 1996.

686. Amorim, *op. cit.*, August 24, 1998. This practice appears to be declining as real salmon from Chile becomes increasingly available in Brazilian seafood markets and supermarkets.

687. BirdLife, *Global Impacts of Fisheries on Seabirds: A paper presented by BirdLife: International for the London Workshop on Environmental Science, Comprehensiveness and Consistency in Global Decisions on Ocean Issues* ED/kc(aquaunit/EDGLOBAL/1853(w6), November 1995, p. 4.

688. The most serious cause of bird mortality worldwide is the birds taking the baited hooks as the line is being set (hooks put into the water). If they become hooked they will drown. The birds have access to the hooks in the short interval between baiting and the time the hook settles to a depth beyond the reach of the birds. Fishermen

differ on the weight put on the line and thus the descent rate varies. The baits are most accessible at the surface, but the baited hook and line take a few minutes to sink to the targeted depth. Some bird species, like comerants, will dive into the water after the bait while it is sinking. A much smaller number of birds are caught when the line is hauled in (retrieved). At this stage entanglements occur and birds may be brought aboard alive. Bird mortalities can result from hooks being left in released birds or unwanted fish or offal being discarded with hooks still attached around the world deliberately kill birds. The primary reason is that lost baits are potentially expensive as unbaited hooks mean that a potential fish is not caught. As individual fish can bring as much as $300-400; a serious bird problem can prove costly to the fishermen. Some birds are also killed for food. The fishermen generally kill the birds by shooting them. The prevalence of these practices in Brazil, however, is largely unknown.

689. N. Brothers, "Albatross mortality and associated bait loss in the Japanese longline fishery in the Southern Ocean," *Biol. Conserv.*, Vol. 55, No. 3, 1995, pp. 255-68.

690. This appears to reflect the larger populations of birds, especially the species which follow fishing boats as a feeding strategy. See the Argentine and Uruguayan chapters of this study for details of fishery-birds interactions in temperate waters. See the Venezuelan chapter for information on fishery-bird interactions in tropical waters.

691. Tatiana Neves, FURG, personal communications, April 1, 1998.

692. An excellent review of the literature is being prepared by John Cooper and Ross Wanless, "The incidental bycatch of seabirds in specific longline fisheries: A world-wide review," to be published by FAO in 1998.

693. See the Venezuelan chapter of this book for available information on the impact of fisheries on seabirds in the Caribbean and other tropical waters.

694. The authors believe that even such preliminary assessments are important. Field research is costly to conduct and both government agencies and environmental groups have finite resources. It is thus important to collect available information, even anecdotal accounts, to help focus the limited available resources on the most critical problems.

695. F. Hazin, op. cit., August 27, 1998.

696. Texeira Gomes, *op. cit.*, August 27, 1998. This species is especially prone to follow in-shore vessels like shrimp trawlers. One observer has sometimes noted hundreds following shrimp trawlers, along with *Fregata magnificens, Sterna hirundinacea, S. maxima, S. eurygbatha*, and *Larus dominicanus*. Sometimes they even land on the vessels to rest, occasionally in large numbers. Most Brazilian fishermen ignore the birds, but some have been known to amuse themselves with such sadistic actions as tieing two together with a fish and then releasing them to watch them fight. Olmos, *op. cit.*, November 29, 1998.

697. F. Hazin, *op. cit.*, August 27, 1998.

698. Humberto Gomes Hazin, UFRPe, personal communications, August 27, 1998.

699. Roberto Teixeira Gomez, Captain of the Heleno, personal communications, August 27, 1998.

700. Broadhurst, op. cit., August 27, 1998.

701. Preliminary work on Caribbean country studies suggests minimal interactions, but the author's work on the Caribbean has just begun. For details see the Caribbean chapter of this report. The authors are planning a series of country studies on Caribbean swordfish fisheries, but these will not be completed until 1999/2000.

702. Information available to the authors, however, refers to operations in the Atlantic (off Spain), the Mediterranean, and the Pacific (off Panama), but not off Brazil. Badosa i Malagelada, *op. cit.*, July 9, 1998.

703. See the Venezuelan chapter of this report for a more complete discussion of seabird interactions experienced by U.S. fishermen in the Caribbean and adjacent areas.

704. See the Venezuelan chapter of this study for details.

705. Gerald Winegard, American Bird Conservency, personal communications, February 24, 1998.

706. BirdLife, *Global Impacts of Fisheries on Seabirds*, a paper presented by BirdLife International for the London Workshop on Environmental Science, Comprehensiveness and Consistency in Global Decisions on Ocean Issues ED/kc(aquaunit/EDGLOBAL/1853(w6), November 1995, p. 18.

707. T.V. Junior, "Seabirds mortality on longline fishing for tuna in southern Brazil," *Ciência e Cultura (São Paulo)* Vol. 43, No. 5, 1991, pp. 388-90.

708. Other mortalities included spectacled petrels (6), wondering albatrosses (4), black-browed albatrosses (2), and an Antarctic fulmar (1). T. Vaske, "Seabird mortality on longline fishing for tuna in southern Brazil," *Ciencia & Cultura*, 1991, No. 43, pp. 388-390. The Vaske article is one of the first assessments known to the author of seabird interactions with fisheries off Brazil.

709. Daily catch rates appeared relatively high, ranging from 0.8-15.0 birds per 1,000 hooks. Bird mortalities were highest during the full moon, presumably because the birds could better acquire the baits during the nighttime sets. Vaske, "Seabird mortality ...," *op. cit.*

710. Several birds were not identified. Some of the major species identified included: black-browed albatross (33 all but 1 juveniles), yellow nose albatross (17 of which 89 percent were juveniles), white-chinned petrel (6), spectacled petrel (6), great shearwater (1), and wandering albatross (1). Tatiana Neves and Fabio Olmos, "Albatross mortality in fisheries off the coast of Brazil," in G. Robertson and R. Gales, (ed.) *Albatross Biology and Conservation* (Chipping Norton: Surrey Beatty & Sons, 1997), pp. 214-219.

711. Neves and Olmos, "Albatross mortality ..., *op. cit.* A rate of 0.12 birds per 1,000 hooks would mean roughly one bird per trip. Given the size of the Brazilian fleet and the level of activity, added together with the higher catch rate of the demersal longliners--a substantial number of birds appear to be affected.

712. Neves and Olmos, "Albatross mortality ..., *op. cit.* A rate of 0.12 birds per 1,000 hooks would mean roughly one bird per trip. Neves and Olmos stress that the 0.12 estimate is a conservative figure. These appear to be many unmonitored boats fishing in Brazilian waters or offshore areas In addition, the fishermen do not always retrieve or record all bird interactions. Given the conservative nature of the bird bycatch estimates, the size of the Brazilian fleet, together with the level of longline activity combined with the higher bycatch rate of the demersal longliners, fishing operations appear to causing a substantial number of bird mortalities, including some species of considerable concern.

713. Several birds were not identified. Some of the major species identified included: black-browed albatross (33 all but 1 juveniles), yellow-nose albatross (17, of which 89 percent were juveniles), white-chinned petrel (6), spectacled petrel (6), great shearwater (1), and wandering albatross (1). T. Neves and F. Olmos, "Albatross mortality in fisheries off the coast of Brazil," in G. Robertson and R. Gales, (ed.) *Albatross Biology and Conservation* (Chipping Norton: Surrey Beatty & Sons, in press), pp. 214-219.

714. Neves and Olmos, "Albatross mortality ...," *op. cit.*

715. Albatrosses do not breed off Brazil, but the waters off Brazil and Uruguay are an important foraging area for both adults and juveniles because they migrate north to more temperate conditions during the southern hemisphere winter (appendix E5b1). One indicator of seasonal climatic conditions are the changing sea-surface temperatures (figures 31-35). Seven species of albatross have been observed in Brazilian waters. H. Sick, *Birds in Brazil: A Natural History* (Princeton University Press, 1993) and C.M. Vooren and A.C. Fernandes, *Guia de Albatrozes e Petréis do Sul do Brazil* (Sagra Editoria: Porto Alegre, 1989). Three of these species (black-browed, yellow-nosed, and wandering) regularly are observed feeding around fishing vessels. Vooren and Fernandes, *Guia de Albatrozes*, *op. cit.* and T. Vaske, "Seabird mortality on longline fishing for tuna in southern Brazil," *Ciência y Cultura*, Vol. 43 (5), pp. 388-390. The birds appear to concentrate along the southern Brazilian and Uruguayan coast where the sub-tropical convergence is particularly strong. Apparently the birds are drawn to this area for the same reason that

oceanic predators are drawn, the concentration of prey species. G.J. Lino and A.S. Mascarenhas, "Sobre a propagção de corrente das Malvinas ao longo da costa sul do Brasil no periodo de 1980-1983," *Anais do IV Congresso Brasileiro de Engenharia de Pesca*, 1985, Curitiba, PR, Brazil. Smaller albatross concentrations are noted further north along the Brazilian coast as the southern winter progresses and the Malvinas Current penetrates further north. The albatross movements and concentration along the Brazilian coast and interactions with fisheries are nicely summarized in Neves and Olmos, "Albatross mortality ...," *op. cit.*

716. Cooper and Wanlass, "The incidental bycatch of seabirds ...," *op. cit.*

717. See the Argentine chapter of this report for details.

718. P.A. Prince, J.P. Croxall, P.N. Trathan, and A.G. Wood, "Foraging strategies of South Georgia albatrosses and relationships with fisheries," *Abstracts from the First International Conference on the Biology and Conservation of Albatrosses*, Hobart, Tasmania, Australia, August 28-September 1, 1995, p. 21.

719. Neves and Olmos, "Albatross mortality ...," *op. cit.* and Olmos, "Seabird attending ...," *op. cit.*

720. See the Uruguayan chapter of this report for details.

721. Karen Alexander, Graham Robertson, and Rosemary Gales, *The Incidental Mortality of Albatrosses in Longline Fisheries*, Report on the Workshop from the First International Conference on the Biology and Conservation of Albatrosses, Hobart, Tasmania, Australia, September 1995, (Australia, March 1997), p. 26.

722. BirdLife, *Global Impacts*, *op. cit.*, p.5.

723. Hoey, *op. cit.*, January 6, 1999.

724. BirdLife, *Global Impacts*, *op. cit.*, p. 13.

725. Neves, *op. cit.*, April 1, 1998.

726. F. H. Hazin, op. cit., August 26, 1998 and Zerbini, op. cit., March 26, 1998.

727. Zerbini, *op. cit.*, March 26, 1998.

728. F. Hazin, op. cit., August 28, 1998.

729. See the Uruguayan chapter of this report for details.

730. Eduardo Secchi and Luciano Dalla Rosa at the Marine Mammal Lab of the Museu Oceanografico in Rio Grande have assessed interactions between killer whales and longline fisheries off southern Brazil. Their paper is currently in press. Eduardo Secchi, Marine Mammal Lab, personal communications, March 19, 1998.

731. The USP researchers are Lucuiano Dalla-Rosa and Eduardo Secchi.

732. Hong, *op. cit.*, July 16, 1996.

733. For details see the Uruguayan chapter of this report.

734. Hong, *op. cit.*, July 16, 1996.

735. Zerbini, *op. cit.*, March 26, 1998.

736. Coelho, *op. cit.*, April 19, 1996.

737. Zerbini, *op. cit.*, March 26, 1998.

738. Imai, *op. cit*, April 19, 1996.

739. F. H. Hazin, op. cit., August 26, 1998.

740. Shoita Babá, *op. cit.*, April 19, 1996.

741. The Honduran registration program is described in detail in Weidner and Hall, "Latin America," *op. cit.*, pp. 20-27 and 189-192.

SECTION XVI. (International)

742. Wise and Le Guen, "The Japanese ...," *op. cit.*

743. SUDEPE, "National report of Brazil," 1986-87 *op. cit.*, p. 254. Another observer reports that the Japanese commercial operations began in 1958. Barros, "Algunos aspectos ...," *op. cit.*

744. Nino de Morais, "Whatever happened ...," *op. cit.*, p. 7.

745. Nino de Morais, "Whatever happened ...," *op. cit.*, p. 7.

746. de Kanel, "SUDEPE fosters ...," *op. cit.*, p. 1. The military coup in 1964 brought to power officials who decided to restrict foreign fishing off Brazil.

747. Tetsu Murata, "Brazilian skipjack tuna fisheries," *Suisan Shuho*, February 5, 1983, pp. 12-15.

748. No fishing, for example, was reported in 1993. Uozumi, "Preliminary analysis ...," *op. cit.*, p. 29.

749. Korean National Fisheries Research and Development Agency, *Fishery Statistics and Fishing Grounds for the Korean Tuna Long Line Fishery, 1988-1992* (NFRDA: Seoul, December, 1993), pp. 87-434.

750. The Spanish also conduct tuna purse-seine operations in the south Atlantic and Indian Oceans. Companies such as Albacora and Atunsa are deploying large purse seiners approaching 2,500 GRT in the fishery. "Un atunero congelador para 'Albacora' y otro para 'Atunsa'," *Industrias Pesqueras*, June 1, 1995, p. 34.

751. Based upon interviews conducted by NMFS contractor Alfonso Zavala with several Spanish fishing companies during June and July 1996.

752. The authors do not have a list of the owners for vessels specifically fishing in the south Atlantic. Data obtained in 1995 on Taiwan vessels reflagging in Honduras showed large numbers of companies with only one or two vessels. Las Fuerzas Armadas de Honduras, La Marina Mercante Nacional, unpublished list, July 14, 1993. For details see Weidner and Hall, *op. cit.*, pp. 195-196. While it is possible that the pattern of ownership for reflagged vessels is different than that for vessels continuing to fly the Taiwan flag, Taiwan sources report that the overall pattern of small-family oriented companies operating one or two vessels is much the same as that reported by the Honduras Navy. Sun, *op. cit.*, September 4, 1998.

753. José Gonzalez, owner, Palangreros del Atlantico, personal communications, June 26, 1996.

754. J. Gonzalez, *op. cit.*, June 20, 1996.

755. J. Gonzalez, *op. cit.*, June 20, 1996.

756. J. Gonzalez, *op. cit.*, June 20, 1996.

757. Da Silva Souza, *op. cit.*, August 27, 1998.

758. For more details on the companies involved, see the Uruguayan chapter of this study.

759. Hsu Ming Hong, China Sea, personal communications, July 16, 1996. For more details on overall Taiwan south Atlantic operations from Montevideo, see the Uruguayan chapter of this study.

760. Taiwan Tuna Research Center, *Annual Catch Statistics of Taiwanese Tuna Longline Fishery* (Taipei: Tuna Research Center, December 1993), pp. F5-8.

761. Taiwan Tuna Research Center, *Annual Catch Statistics of Taiwanese Tuna Longline Fishery*, *op. cit.* pp. F21-24.

762. Taiwan Tuna Research Center, *Annual Catch Statistics of Taiwanese Tuna Longline Fishery*, *op. cit.* pp. F25.

763. Hsu Ming Hong, *op. cit.*, July 16, 1996.

764. "Taipei volunteers to reduce tuna fishing in the Atlantic," Taiwan Central News Agency, 0713 GMT, April 29, 1998.

765. Da Silva Souza, *op. cit.*, August 27, 1998.

766. F. H. Hazin, *op. cit.*, August 25, 1998.

767. The Brazilian scientists have, however, provided no details as to the names of the fishermen and vessels, when they operated, or the ports from which they operated. Michael Bailey, NMFS, personal communications, September 5, 1996.

768. Jean Cramer and Heather Adams, "Large pelagic logbook newsletter-1996," *NOAA Technical Memorandum*, NMFS-SEFSC-407, January 1998, p. 3.

769. Cramer and Adams, "Large pelagic logbook newsletter-1996," *op. cit.*, p. 3.

770. INFOPESCA, "Firma de carta intención entre Venezuela and Brazil para el acceso de la flota atunera venezolano en aguas terrioriales Brasileras," *Noticias Comerciales*, June 5, 1991.

771. ICCAT, "Report of the meeting of panel 4," *ICCAT Report* Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), p. 97.

772. Brazilian officials have been unable to fully support ICCAT billfish programs. ICCAT, "Third plenary session," *ICCAT Report* Part I, 1986-87 (ICCAT: Madrid, Spain, 1987), p. 51.

773. Portaria 115 issued August 17, 1998.

774. This observations is based on visits to Brazil in 1996 (before the Brazilian regulations were implemented) and 1998 (after they were implemented).

775. Antero da Silva, "Tuna fishery in Brazil ...," *op. cit.*, p. 184.

776. F. Hazin, *op. cit.*, August 26, 1998.

777. Duarte da Silva, *op. cit.*, April 17, 1996; Imai, *op. cit.*, April 19, 1996; and Werner Hadrich, *op. cit.*, April 17, 1996.

778. Araújo Neto, *op. cit.*, April 19, 1996.

779. The Taiwan longliners often have substantial numbers of mainland Chinese crews as it is proving increasingly difficult to recruit Taiwan fishermen because of the lengthy trips, rigorous working conditions, and relatively low salaries. Chi-lu Sun, National Taiwan University, personal communications, September 4, 1998.

780. "Barbados goes lining with bigger boats," *Fishing News International*, November, 1993. p. 52.

781. F.H. Hazin, *op. cit,* August 25, 1998.

782. Four of the longliners reportedly had been fishing out of Trinidad. Nelson Beidemann, Blue Water Fishermen's Association, personal communications, June 20, 1995.

783. For details see Weidner and Hall, *op. cit.*

784. "Brazil enters the tuna fishing club," *Revista Nacional de Pesca*, No. 160, November, 1976, p. 34.

785. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 125.

786. Uozumi, "Preliminary analysis ...," *op. cit.*, p. 29 and ICCAT, "1994 SWO background document: Figures," *ICCAT Collective Volume of Scientific Papers* (ICCAT: Madrid, Spain, 1995), p. 91.

787. ICCAT, "1994 SWO background document: Figures," *op. cit.*, p. 91.

788. "Brazil enters the tuna fishing club," *op. cit.*, p. 34.

789. For details see Weidner and Hall, *op. cit.*

790. F. H. Hazin, *op. cit.*, August 25, 1998.

791. Da Silva Souza, *op. cit.*, August 28, 1998.

792. ICCAT, "SCRS figures," *ICCAT Report*, Part II, 1990-91 (ICCAT: Madrid, Spain, 1992), p. 201.

793. Spanish South Atlantic effort was particularly concentrated in the mid-Atlantic and Gulf of Guinea, 0°-5°S, west of 30°W and 25°-35°S, from 40°-25°W. ICCAT, "1994 SWO background document: Figures," *op. cit.*, p. 91.

794. See the Uruguayan chapter of this report for details.

795. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 125, 128-129.

796. Van Eijs, *op. cit.*, October 6, 1992.

797. F. Hazin, *op. cit.*, July 17, 1996.

798. Da Silva Souza, *op. cit.*, August, 1998.

799. Menezes de Mello, Vaske, and Castello, "Pesqueria ...," *op. cit.*, p. 125.

800. Several other Taiwan companies are active in the south Atlantic. See the Uruguayan chapter of this report for more details on these companies.

801. Hong, *op. cit.*, July 16, 1996.

802. Hong, *op. cit.*, July 16, 1996.

803. Da Silva Souza, *op. cit.*, August 28, 1998.

804. Jean Cramer, "Spatial analysis of swordfish landings and cryptic catch from the U.S. longline fishery, *ICCAT Working Document*, SCRS/95/102, pp. 5-8.

805. Jean Cramer, NMFS-F/SEC, personal communications, October 20, 1995.

806. Four U.S. longliners reportedly have been fishing out of Trinidad. Nelson Beidemann, Blue Water Fishermen's Association, personal communications, June 20, 1995.

807. For details on the U.S. operations out of Montevideo, Uruguay, see the Uruguayan chapter of this report.

808. Jean Cramer, "Large pelagic logbook newsletter -1994," *NOAA Technical Memorandum*, NMFS-SEFSC-378 (NMFS/Southeast Fisheries Science Center: Miami, November 1995), p. 3.

809. F. Hazin, *op. cit.*, July 17, 1996.

810. INFOPESCA, "Empresa conjunta atunera con Venezuela: Una posibilidad," *Noticias Comerciales*, November 23, 1988.

811. "Proyecto para la implementación de un polo de pesca para el atún en el estado de Ceara," *INFOPESCA Noticias Comerciales*, June 20, 1992.

812. IDB, "IDB approves $1.75 million for coastal zone management in Brazil," *IDB News Release, NR-03/98,* January,14, 1998.

813. "How two western countries are stepping up support for third world fisheries: Canadian aid tops $45 million," *Fishing News International,*" April, 1980, p. 26-27; "Seafood textbooks for Brazil," *Canadian Fishing Report*, April, 1984; and Denise Hillier, "MUN group shows Brazilians fish processing technology," *The Evening Telegram*, February 5, 1988.

814. "Navy concerned over fishing activities along coast," *Correio Braziliense*, July 10, 1982.

815. "Other agreements with China," *The Latin American Times*, August 17, 1984.

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Appendices

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Appendix A1a.--Brazil. Domestic fishing vessels, 1982-96

Year	Longliner				Total	Bait boat		Purse seiner	Unclassified	Total
	0-50*	51-200*	201-500*	501*		Icewell	Freezer			
						Number of vessels				
1982	-	8	-	-	8	97	-	-	-	105
1983	-	12	-	-	12	57	-	-	-	69
1984	-	12	-	-	12	47	-	-	-	59
1985	-	10	-	-	10	50	-	-	-	60
1986	2	8	1	-	11	42	9	-	-	62
1987	2	7	1	-	10	43	-	-	-	53
1988	2	1	-	-	3	46	-	-	-	49
1989	-	17	-	-	17	47	-	-	-	64
1990	2	19	-	-	21	51	-	-	-	72
1991	2	2	-	-	4	52	-	-	-	57
1992	2	15	-	-	17	51	6	-	-	74
1993	2	17	-	-	19	50	7	-	-	76
1994	3	13	-	-	16	47	7	-	-	70
1995	3	13	-	-	16	46	7	-	-	69
1996	-	23	-	-	23	46	0	-	-	69

* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b1.--Brazil. Fishing vessels leased with Barbados flags, 1982-96

Year	Longliner				Bait boat		Purse seiner	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer			
					Number of vessels				
1995	-	-	2	-	-	-	-	-	2
1996	-	-	2	-	-	-	-	-	2

Note: No Barbados vessels reported before 1995.
* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b2.--Brazil. Fishing vessels leased with Cayman Islands flags, 1982-96

Year	Longliner				Bait boat		Purse seiner	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer			
							Number of vessels		
1982	-	-	-	-	2	-	1	-	3
1983	-	-	-	-	-	1	1	-	2

Note: No Cayman vessels reported after 1983.
* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b3.--Brazil. Fishing vessels leased with Honduran flags, 1982-96

Year	Longliner				Bait boat		Purse seiner	Troller	Rod\Reel	Hand-line	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer						
							Number of vessels					
1990	-	-	-	-	-	-	-	-	-	-	-	-
1991	-	1	-	-	-	-	-	-	-	-	-	1
1992	-	1	-	-	-	-	-	-	-	-	-	1
1993	-	1	-	-	-	-	-	-	-	-	-	1
1994	-	2	-	-	-	-	-	-	-	-	-	2
1995	-	1	-	-	-	-	-	-	-	-	-	1
1996	-	2	-	-	-	-	-	-	-	-	-	2

Note: No Honduran vessels reported before 1991.
* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b4.--Brazil. Fishing vessels leased with Japanese flags, 1982-96

Year	Longliner				Bait boat		Purse seiner	Troller	Rod\Reel	Hand-line	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer						
							Number of vessels					
1982	-	1	5	-	-	1	-	-	-	-	-	7
1983	-	-	4	-	-	3	-	-	-	-	-	7
1984	-	-	3	-	-	6	-	-	-	-	-	9
1985	-	-	3	-	-	4	-	-	-	-	-	7
1986	-	1	5	-	-	6	-	-	-	-	-	12
1987	-	1	4	-	-	8	-	-	-	-	-	13
1988	-	1	4	-	-	5	-	-	-	-	-	10
1989	-	-	5	-	-	-	-	-	-	-	-	5
1990	-	-	5	-	-	7	-	-	-	-	-	12
1991	-	-	2	-	-	-	-	-	-	-	-	2
1992	-	-	1	-	-	-	-	-	-	-	-	1
1993	-	-	2	-	-	-	-	-	-	-	-	2
1994	-	-	2	-	-	-	-	-	-	-	-	2
1995	-	-	2	-	-	-	-	-	-	-	-	2
1996	-	-	-	-	-	-	-	-	-	-	-	-

* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b5.--Brazil. Fishing vessels leased with Korean flags, 1982-96

Year	Longliner				Bait boat		Purse seiner	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer			
							Number of vessels		
1994	-	-	2	-	-	-	-	-	2
1995	-	-	2	-	-	-	-	-	2
1996	-	-	-	-	-	-	-	-	-

Note: No Korean vessels reported after before 1994
* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b6.--Brazil. Fishing vessels leased with Portuguese flags, 1982-96

Year	Longliner				Baitboat		Purse seiner	Troller	Rod\Reel	Hand-line	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer						
							Number of vessels					
1992	-	-	2	-	-	-	-	-	-	-	-	2
1993	-	-	-	-	-	-	-	-	-	-	-	0
1994	-	-	-	-	-	-	-	-	-	-	-	0
1995	-	-	-	-	3	-	-	-	-	-	-	3
1996	-	-	-	-	3	-	-	-	-	-	-	3

Note: No Portuguese vessels reported before 1992.
* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b7.--Brazil. Fishing vessels leased with Spanish flags, 1982-96

Year	Longliner				Baitboat		Purse seiner	Troller	Rod\Reel	Hand-line	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer						
							Number of vessels					
1982	-	-	-	-	3	-	-	-	-	-	-	3
1983	-	-	-	-	-	-	2	-	-	-	-	2
1984	-	-	-	-	-	-	2	-	-	-	-	2
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-
1990	-	-	-	-	-	-	-	-	-	-	-	-
1991	-	-	-	-	-	-	-	-	-	-	-	-
1992	-	-	-	-	-	-	-	-	-	-	-	-
1993	-	1	-	-	-	-	-	-	-	-	-	1
1994	-	-	-	-	-	-	-	-	-	-	-	-
1995	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	3	-	-	-	-	-	-	-	-	-	3

* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1b8.--Brazil. Fishing vessels leased with Taiwan flags, 1982-96

Year	Longliner				Baitboat		Purse seiner	Troller	Rod\Reel	Hand-line	Unclassified	Total
	0-50*	51-200*	201-500*	501*	Icewell	Freezer						
							Number of vessels					
1982	-	-	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-	-
1990	-	-	-	-	-	-	-	-	-	-	-	-
1991	-	-	11	-	-	-	-	-	-	-	-	11
1992	-	-	15	-	-	-	-	-	-	-	-	15
1993	-	-	12	20	-	-	-	-	-	-	-	32
1994	-	-	20	-	-	-	-	-	-	-	-	20
1995	-	-	14	-	-	-	-	-	-	-	-	14
1996	-	-	14	-	-	-	-	-	-	-	-	14

* Vessel size (gross registered tons)
Source: ICCAT. *Statistical Bulletin*, various years.

Appendix A1c.--Brazil. Longline and baitboat fleet, 1982-96

Fleet/Country	State#	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996&
		Year														
		Number														
Baitboats																
National fleet																
Brazil	Rio de Janeiro	NA	NA	NA	NA	NA	NA	NA	19	15	22	25	23	21		
Brazil	Santa Catarina	NA	NA	NA	NA	NA	NA	NA	12	10	22	32+	30++	29++		
Brazil	Rio Grande do Sul	NA	NA	NA	NA	NA	NA	NA	-	-	-	-	4+++	4+++		
Brazil	Both RJ/SC	NA	NA	NA	NA	NA	NA	NA	16	26	9	-	-	-		
Subtotal, Brazil		97	57	47	50	42	43	46	47	51	53	57	57	54	56	49
Leased fleet*																
Japan	Santa Catarina	5	4	6	5	6	5	5	5	7	4	-	-	-	3	3
Subtotal, baitboats		102	61	53	55	48	48	51	52	58	57	57	57	54		
Longliners																
National fleet																
Brazil	Sao Paulo (Santos)	7	9	9	6	6	6	-###	9	11	13	14	14	13		
Brazil	Rio Grande do Sul	1	2	2	2	2	2	3	-	-	-	-	-	-		
Brazil	Rio Grande do Norte	-	1	1	2	3	3	3	8	10	4	3	5	3		
Subtotal, Brazil		8	12	12	10	11	11	3	17	21	17	17	19	16	16	23
Leased fleet*																
Honduras*	Santa Catarina	-	-	-	-	-	-	-	-	1	1	1	1	2	1	2
Japan*	Rio Grande do Sul	6	4	3	3	6	5	5	5	5	2	1	2	2	2	2
Korea	Rio Grande do Sul	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-
Panama	São Paulo (Santos)	-	-	-	-	-	-	-	-	-	-	1	1	1	3	3
Portugal	São Paulo (Santos)	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-
Taiwan*##	Rio Grande do Sul	-	-	-	-	-	-	-	-	-	11	15	18	10	2	2
Taiwan*##	Para	-	-	-	-	-	-	-	-	-	-	11	14	10	1	2
Subtotal, leased foreign		6	4	3	3	6	5	5	5	6	14	31	36	27	11	7
Subtotal, longliners		14	16	15	13	17	16	8	22	27	31	48	55	43	27	30
Total		116	77	68	68	65	64	59	74	85	88	105	112	97	83	79

* Foreign-owned vessels leased by Brazilian companies and licensed to fish in Brazilian waters.
** The major ports are:
Para: Recife: Pernambuco
Rio Grande do Norte: Natal and Areia Branca
Rio Grande do Sul: Rio Grande, Pelotas, Porto Alegre, Etrela and Charqueadas
Santa Catarina: Sao Francisco do Sul, Itajaí and Imbituba
São Paulo: Santos (the major port serving the huge industrial complex around Sao Paulo).
& As of April 1996.
# State where base port is located.
Often referred to as China in Brazilian publications.
This may be a statistical error as the authors note that the catch reported by the Brazilian longline fleet increased significantly in 1988 (appendix E3b1a).
+ Includes six freezer baitboats exceeding 151 GRT
++ Includes 2 and 3 baitboats in 1993 and 1994, respectively
+++ Freezer baitboats over 151 GRT
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 336; J.H. Meneses de Lima, "National report of Brazil," for 1995 ICCAT meeting (1982-94 data) and Instituto de Pesca (1995-96 data).

Appendix A2a1.--Brazil. Longliners, 1979-96

Year	Longliners		Total
	Domestic	Leased*	
	Number		
1979	5	5	10
1980	5	3	8
1981	5	4	9
1982	7	5	12
1983	12	4	16
1984	12	2	15
1985	10	3	13
1986	11	6	17
1987	11	5	16
1988	3**	5	8**
1989	17	5	22
1990	21	6	27
1991	17	14	31
1992	17	30	47
1993	19	36	55
1994	16	27	43
1995	16	11	27
1996	23	7	30

* Leased
** Does not include the Santos longlinè fleet.
Note: Discrepancies with appendix A1C are unexplained.
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1990-91 (ICCAT: Madrid, Spain, 1991), p. 409 (1979-89 data) and J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 336; and J.H. Meneses de Lima, "National report of Brazil," for 1995 ICCAT meeting (1990-94); and Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (I), p. 141 (1995 data); and ICCAT, *Statistical Bulletin*, 1996 (1996 data).

Appendix A2a2.--Brazil. Domestic and foreign tuna/swordfish longliners operating in Brazil, 1992-95

Fleet*	Base port state**	Year 1992	1993	1994	1995
		Vessels			
Brazil					
	Rio Grande do Norte	3	5	3	3
	São Paulo	14	14	13	13
	Total	17	19	16	16
Leased					
Barbados					
	São Paulo	-	-	-	2
Honduras					
	São Paulo	1	1	2	1
Japan					
	Rio Grande do Sul	1	2	2	2
Korea					
	Rio Grande do Sul	-	-	2	2
Panama					
	São Paulo	-	1	1	-
Portugal					
	São Paulo	2	-	-	1
Taiwan					
	Para	11	14	10	-
	Paraíba	-	-	-	14
	Rio Grande do Sul	15	18	10	-
Total		30	36	27	22
Total		47	55	43	38

* By flag of registration
** Ports:
Para: Pernambuco
Paraíba: Cabedelo
Rio Grande do Norte: Natal and Areia Branca
Rio Grande do Sul: Rio Grande, Pelotas, Porto Alegre, Etrela and Charqueadas
São Paulo: Santos
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (Vol. I, Part 2), (ICCAT: Madrid, 1997), p. 138.

Appendix A2b.--Brazil. Characteristics of domestic longline vessels

Characteristic	Measurement units	Brazilian built*	Japanese built	American built
		Representative characteristic		
Length	Meters	16-25	25-30	NA
Size				
Gross	GRT	50-100	100-200	NA
Net	NRT	NA	NA	NA
Hull		Wood/Steel	Steel	NA
Trip length	Days	NA	20-25	NA
Crew	Members	NA	17	NA
Hold type		Ice hold	Ice holds	NA
Hold capacity		NA	NA	NA
Length of longline	Kilometers	NA	80-90	NA
Hooks deployed		NA	1,500	NA

* Few domestic-built vessels are purpose-built longliners, but rather older vessels refitted for longlining. Some longliners, however, were under construction in Brazilian yards during 1998.
Source: Interviews with various Brazilian companies and researchers.

Appendix A2c1a.--Brazil. Characteristics of leased foreign longline vessels

Characteristic	Japanese 1977-89	Taiwan 1991-92
Length	48.5 meters	42.5 meters
Size		
Gross	326 tons	421 tons
Net	NA	195 tons
Autonomy	90 days	90-120 days
Crew	25 persons	25 persons
Hold capacity	398 tons	390-520 tons
Freezing capacity (per day)	NA	5.7 tons
Length of longline	135 kilometers	135 kilometers

Source: J.N. Antero-Silva, "Desempenho de frota atuneira arrendada de 1977 a 1989," *Informe IBAMA*, mimeo, 1990, 16 p and crew members as cited in Rogerio Menezes de Mello, Teodoro Vaske Jr., and Jorge P. Castello, "Pesqueria de atunes y pez espada por la flota arrendada de Rio Grande, Brazil," *Frente Marítimo*, Vol. 14, Sec. A, 1993, p. 126.

Appendix A2c1b.--Brazil. Characteristics of leased foreign longline vessels

Characteristic	Japanese		Taiwan	Korean
	Large (1977-95)	Small (1979-88)	(1991-94)	(1994-95)
Number of vessels	21	2	18	2
Length	50.8 meters	26.6 meters	45.5 meters	46.5 meters
Size				
Gross	348 GRT	89 GRT	505 GRT	254 GRT
Hold	459 tons	64 tons	499 tons	292 tons
Speed	11 knots	NA	11.3 knots	11 knots
Crew				
Brazilian	5	NA	6	6
Foreign	16	NA	19	19
Horsepower	1,170	600	1,010	1,000

Source: Jose Nelson Antero da Silva, IBAMA/CEPERG, personal communications, May 15, 1996.

Appendix A2c1c.--Brazil. Characteristics of the leased Japanese longliners

Vessel	Number	Length			Size			Oil capacity			Fish capacity		
		Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
		Meters			GRT			Tons			Metric tons		
Large	19	42.0	60.5	50.5	282	474	348	203	554	328	350	676	457
Small	2	24.5	28.7	26.6	82	97	89	31	66	48	46	83	64
Total	21	66.5	89.2	77.1	364	571	437	234	620	376	396	759	521

Source: J. Nelson Antero da Silva, "Tuna fishery in Brazil by leased Japanese longliner fleet from 1977 to 1991," *ICCAT Collective Volume of Scientific Papers*, Report of the Second ICCAT Billfish Workshop, Miami, Florida, July 22-29, 1992 (ICCAT: Madrid, 1994, p. 185.

Appendix A2c1d.--Brazil. Spanish longline vessel characteristics

Vessel	Spanish company	Built		Length	Size	
		Country	Year		Vessel	Hold
				Meters	GRT	Tons
Brazilian licenses (association contracts)						
Cosmos	NA	Spain	1985	25+	138	NA
Unknown	NA	NA	NA	25+	NA	NA
Without Brazilian licenses						
Alicante*	Palangreros del Atlantico	Japan	NA	NA	NA	NA
Virgen de Franqueira	Palangreros del Atlantico	Spain	1962	NA	186	NA

NA - Not available
* Purchased by the Guinea TRAMER company and reflagged in Guinea. The name of the vessel has been changed to the *Sakoba*.
Source: Interviews with Spanish fishing companies; Fabio Hazin, personal communications, July 17, 1996; and Office of Naval Intelligence, personal communications, July 10, 1996.

Appendix A2c2a.--Brazil. Longliners based in Rio Grande, 1979-96

Year	Nationality				Total
	Brazil	Japan	Taiwan	Korea	
		Number			
1977	-	3	-	-	3
1978	NA	NA	NA	NA	NA
1979	-	5	-	-	5
1980	-	5	-	-	5
1981	-	4	-	-	4
1982	1	6	-	-	7
1983	2	4	-	-	6
1984	2	3	-	-	5
1985	2	6	-	-	8
1986	2	5	-	-	7
1987	2	5	-	-	7
1988	-	5	-	-	5
1989	-	5	-	-	5
1990	-	5	-	-	5
1991	-	2	11	-	13
1992	-	1	15	-	16
1993	-	2	18	-	20
1994	-	2	10	2	14
1995	-	2	-	2	4
1996	-	-	-	-	-

NA - Not available
Source: Rogerio Menezes de Mello, Teodoro Vaske Jr., and Jorge P. Castello, "Pesqueria de atunes y pez espada por la flota arrendada de Rio Grande, Brazil," *Frente Marítimo*, Vol. 14, Sec. A, 1993, pp. 125-126 (1977-90 data); J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 336 (1991-92 data); and J. Nelson Antero da Silva, CPERG/IBAMA, personal communications, IBAMA, personal communications, April 17, 1996 (1992-96 data).

Appendix A2c2b.--Brazil. Longliners based in Itajaí, Santa Catarina, 1979-96

Year	Nationality		Total
	Brazil	Honduras	
	Number		
1979-89	-	-	-
1990	-	1	1
1991	-	1	1
1992	-	-	-
1993	-	-	-
1994	-	-	-
1995	-	-	-
1996	-	(3)*	-
1997	NA**	NA	NA**
1998	NA**	NA	NA**

NA - Not available
* Three Santos longliners were reportedly in Itajaí during 1996 for repairs, but were not fishing out of the port.
** Santos sources indicate that rising port costs have caused several vessels which once operated out of Santos to shift operations to Itajaí.
Source: IBAMA.

Appendix A2c3.--Brazil. Longliners deployed in the tuna-swordfish longline fishery, 1970-96

Vessel	Original nationality#	Reflagged in Brazil	Port##	Years*	Company** Brazilian	Company** Foreign
Alfa	NA	Yes	Natal	19??-96	Individual####	
Argus	NA	Yes	Natal	19??-96	Norte Pesca	
Atlantic Core	Honduras	No	Santos	1992-93	Kawai	
Chidori Maru 20	Japan	No	Rio Grande	1993-95	Leal Santos	
Choko Maru 71	Japan	No	Rio Grande	1988-90	Leal Santos	
Choko Maru 78	Japan	No	Rio Grande	1985-87	Leal Santos	
Choko Maru 81	Japan	No	Rio Grande	1985-87	Leal Santos	
Collen Cheramie	Barbados	No	Santos	1995-96	Imaipesca	
Cosmos	Spain	No	Cabedelo	??-1996	Cabedelo Pesca	
Dai Maru 58	Japan	No	Rio Grande	1988-90	Leal Santos	
Daishin Maru 25	Japan	No	Rio Grande	1986-89	Leal Santos	
Ebisu Maru 1	Japan	No	Rio Grande	1990	Leal Santos	
Ebisu Maru 75	Japan	No	Rio Grande	1989-91	Leal Santos	
Fukulyu Maru 3	Japan	No	Rio Grande	1982-84	Leal Santos	
Fukulyu Maru 8	Japan	No	Rio Grande	1982-84	Leal Santos	
Fukulyu Maru 25	Japan	No	Rio Grande	1982-84	Leal Santos	
Gwo Been	Taiwan	No	Rio Grande	1991-94	Leal Santos	China Sea
Imaipesca	Brazil	NA	Santos	1981-96	Imaipesca	
Itaberaba	Japan	Yes	Santos	1974-93	Ono brothers	
Itaipu 1	Brazil	NA	Santos	1976-95	Ono brothers	
Itamarati	Brazil	NA	Santos	1970?-73	Ono brothers	
Itaoca	Brazil	NA	Santos	1977-95	Ono brothers	
Itapui 1	Brazil	NA	Santos	1983-96	Ono brothers	
Itauna***	Brazil	NA	Santos	1970?-81	Ono brothers	
Itauna 1	Japan	Yes	Santos	1985-96	Ono brothers	
Jer Dos	Panama	No	Santos	1993-94	Kawai	
Julius****	Panama	No	Santos	1996	Kawai	
Kaiko Maru 16	Japan	Yes	Northeast	1950s-70s		
			Santos	1970s-96	Imaipesca	
Kao Feng 10	Taiwan	No	Rio Grande	1992-93	Pescal	
Kao Fong 3	Taiwan	No	Rio Grande	1992-93	Pescal	
Kao Fong 5	Taiwan	No	Rio Grande	1992-93	Pescal	
King of Kings	Barbados	No	Santos	1995-96	Imaipesca	
Koei Maru	Japan	No	Rio Grande	1992-95	Leal Santos	
Kuo Ning	Taiwan	No	Rio Grande	1991-94	Leal Santos	China Sea
Kuo Sheng	Taiwan	No	Rio Grande	1991-94	Leal Santos	
Mari 1	Japan	No	Rio Grande	1986-88	Torquato Pontes	
Namorado	NA	Yes	Natal	19??-96	Individual####	
Nankai Maru 8	Japan	No	Rio Grande	1979-80	Leal Santos	
(La) Paloma	Brazil	No	Santos	1974-75	Alfredo Napolitano	
Peixoto Ramos	NA	Yes	Natal	19??-96	Individual####	
Pescador	NA	Yes	Natal	19??-96	Individual####	
Río E'brio	Brazil	No	Santos	1973-74	NA	
Río Turi	NA	Yes	Natal	19??-96	Norte Pesca	
Rainha do Mar	NA	Yes	Natal	19??-96	Individual####	
Santana 77	Korea	No	Rio Grande	1994-95	Leal Santos	
Sea Wolf	Honduras	No	Santos	1994-96	Kawai	
Seiko Maru 8	Japan	No	Rio Grande	1977-80	Leal Santos	
Seneca	United States	No	Recife	??-1996	Norte Pesca	
Sumiyoshi	Japan	No	Rio Grande	1981	Leal Santos	
Sumiyoshi Maru 8	Japan	No	Rio Grande	1977-80	Leal Santos	
Sumiyoshi Maru 18	Japan	No	Rio Grande	1981-83	Leal Santos	
Sumiyoshi Maru 32	Japan	No	Rio Grande	1977-80	Leal Santos	
Sumiyoshi Maru 52	Japan	No	Rio Grande	1981-83	Leal Santos	
Sumiyoshi Maru 68	Japan	No	Rio Grande	1981-82	Leal Santos	
Taifan 1	Taiwan	No	Rio Grande	1992-93	Pescal	
Taihei Maru 3	Japan	Yes	Rio Grande	1979-91	Leal Santos	
			Santos	1991-96		
Tooshin Maru 101	Japan	Yes	Santos	1988-96	Kawai	
Tooshin Maru 102	Japan	Yes	Santos	1982-96	Kawai	
Tooshin Maru 103	Japan	Yes	Santos	1983-96	Kawai	
Tooshin Maru 104	Japan	Yes	Santos	1988-96	Kawai	
Tooshin Maru 105	Japan	Yes	Santos	1990-96	Kawai	
Tooshin Maru 106	Japan	Yes	Santos	1990-96	Kawai	
Sum M 8	Japan	No	Rio Grande	1977-80	Leal Santos	
Sum M 32	Japan	No	Rio Grande	1977-80	Leal Santos	

Sum M 16	Japan	No	Rio Grande	1981-82	Leal Santos	
Sum M 68	Japan	No	Rio Grande	1981-82	Leal Santos	
Sum M 52	Japan	No	Rio Grande	1981-82	Leal Santos	
Yu Jin	Korea	No	Rio Grande	1994-95	Leal Santos	
Yuko Maru 68	Japan	No	Rio Grande	1990-91	Leal Santos	
Yuko Maru 78	Japan	No	Rio Grande	1986-89	Leal Santos	
Yung An	Taiwan	No	Rio Grande	1991-94	Leal Santos	China Sea
Yung Chien	Taiwan	No	Rio Grande	1993-94	Leal Santos	China Sea
Yung Ching	Taiwan	No	Rio Grande	1991-93	Leal Santos	
Yung Chow	Taiwan	No	Rio Grande	1991-94	Leal Santos	China Sea
Yung-gi Men	Taiwan	No	Rio Grande	1993-94	Leal Santos	
Yung Hai	Taiwan	No	Rio Grande	1991-94	Leal Santos	
Yung Hsua	Taiwan	No	Rio Grande	1993-94	Leal Santos	
Yung Kai	Taiwan	No	Rio Grande	1993-94	Leal Santos	
Yung Kuo	Taiwan	No	Rio Grande	1991-94	Leal Santos	China Sea
Yung Pang	Taiwan	No	Rio Grande	1991-94	Leal Santos	China Sea
Yung Yang	Taiwan	No	Rio Grande	1991-94	Leal Santos	
Yung Yu	Taiwan	No	Rio Grande	1991-94	Leal Santos	
Unknown###	Japan	No	Recife	1956-64		
Unknown	Spain	No	Cabedelo	??-1996	Cabedelo Pesca	

NA - Not available/not applicable
The Honduran and Panamanian-flag vessels are flag-of-convenience registrations. The actual owners are from Spanish, the United States, and other countries. For details on the Honduran and Panamanian flag-of-convenience registrations see Dennis Weidner and David Hall, "Latin America," *World Fishing Fleets* (NMFS: Washington D.C., November, 1993).
Principal port of operations. Many of these vessels shifted operations seasonally and as a result may have called at other Brazilian ports or operated temporarily out of other ports. The ports are in the indicated states:

Cabedelo - Paraíba
Natal - Rio Grande do Norte
Recife - Pernambuco
Rio Grande - Rio Grande do Sul
Santos - São Paulo

Brazilian companies leased 12 Japanese longliners during 1956-64 for operations out of Recife, but the authors have no details on those vessels.
Operate in association with Norte Pesca during 1996.
* Years in which the vessels are known to have operated off Brazil
** The Brazilian companies leasing foreign longliners and deploying domestic longliners are described in detail in the text of the report. The authors have been unable to obtain information on the foreign companies supplying the vessels.
*** Sank
**** As of April 1996 had not yet begun fishing.
Note: The authors believe that the above list covers most of the foreign longliners which have been deployed in Brazilian waters under leasing arrangements which began in 1977 with Brazilian companies. Several have been reflagged in Brazil and incorporated intro the Brazilian fleet. Most of the above information comes from sources in Rio Grande and Santos, the primary ports. It is likely that a small number of additional vessels may have been leased.
Source: Carlos Alberto Arfelli, Instituto de Pesca, Santos, commercial communications, April 19 and July 16, 1996;
Jose Nelson Antero da Silva, IBAMA/CEPERG, personal communications, May 15 and June 26, 1996; and Fabio Hazin, personal communications, July 17 and 30, 1996.

Appendix A2c4.--Brazil. Taiwan companies leasing longliners to Brazilian companies, 1991-94

Company	Vessel	Port	Years leased	Size	Built	
					Year	Country
				GRT		
China Sea Products						
	Gwo Been	Rio Grande	1991-94	352	1983	Taiwan
	Yung An	Rio Grande	1991-94	352	1983	Taiwan
	Yung Chien	Rio Grande	1993-94	350	1982	Taiwan
	Yung Chow	Rio Grande	1991-94	352	1981	Taiwan
	Yung Kuo	Rio Grande	1991-94	350	1982	Taiwan
	Yung Pang	Rio Grande	1991-94	352	1983	Taiwan
Unknown						
	Kao Feng 10	Rio Grande	1992-93			
	Kao Fong 3	Rio Grande	1992-93			
	Kao Fong 5	Rio Grande	1992-93			
	Kuo Ning	Rio Grande	1991-94			
	Kuo Sheng	Rio Grande	1991-94	709	1989	NA
	Taifan 1	Rio Grande	1992-93			
	Yung Ching	Rio Grande	1991-93			
	Yung-gi Men	Rio Grande	1993-94			
	Yung Hai	Rio Grande	1991-94	492	1985	Taiwan
	Yung Hsua	Rio Grande	1993-94	796*	1987*	Taiwan*
	Yung Kai	Rio Grande	1993-94	796	1987	Taiwan
	Yung Yang	Rio Grande	1991-94	492	1985	Taiwan
	Yung Yu	Rio Grande	1991-94			

Note: One Taiwan source indicates that most of the vessels are quite similar in design, about 43-50 m long, 420 GRT, and have hold capacities of about 250 tons. Vessel data from ONI indicates somewhat different characteristics.
* The ONI listing is for the *Yung Hsuan*.
Source: Various company records and the Office of Naval Intelligence (ONI), statistical printout, August 1, 1996.

Appendix A2c5.--Spain. Longline operations off Brazil

Vessel	Spanish company	Grounds		Years	Home port	Transhipment points
		Latitudes	Areas			
Within Brazilian waters						
Cosmos	NA	NA	Northern Brazil	??-1996	NA***	Cabedelo
Unknown	NA	NA	Northern Brazil	??-1996	NA***	Cabedelo
Outside Brazilian waters						
Alicante**	Palangreros del Atlantico	5°N-25°S	Primarily Africa*	??	Vigo	Walvis Bay#/Montevideo
Virgen de Franqueira	Palangreros del Atlantico	5°N-25°S	Primarily Africa*	??	Vigo	Walvis Bay#/Montevideo

* Seasonal operations off Brazil outside of the 200-mile limit.
** Purchased by the Guinea TRAMER company and reflagged in Guinea. The name of the vessel has been changed to the *Sakoba*.
*** Probably Vigo.
# Spanish merchant vessels dock in Walvis Bay bringing supplies from home, including bait, food, and other items.
Note: A complete list of the Spanish longliners operating in the south Atlantic is available in Uruguay appendix E2b. Most of those vessels are believed to at least occasionally operate off Brazil outside the 200-mile zone. The vessels listed here are vessels which belong to Spanish companies that the authors have been able to contact.
Ports:
Cabedelo - Brazil
Montevideo - Uruguay
Vigo - Spain
Walvis Bay - Namibia
Source: Interviews with Spanish fishing companies and Fabio Hazin, personal communications, July 17, 1996.

Appendix A2d1.--South America. Characteristics of Spanish longliners operating off South America, 1996

Vessel*	Built/ Refurbished	Size			Freezer#	Longline		Crew
		Length	Tonnage	Hold		Length	Hooks	
	Year	Meters	GRT	Tons	Celsius	Kilometers	Number	Persons
Alicante	1966/1988	NA	170	NA	-30°	8	800	20-23
Arosa Primera		36	300	120	-28°	10	500	15-17
Maicoa		36	500	185	-35°	65	4,000	18-20
Maicoa I								
Urugora								
Virgen de la Franqueira	1966	NA	180	NA	-30°	8	800	20-24

* A complete list of Spanish longliners operating in the south Atlantic indicating the owner is detailed in Uruguay, appendix E2b.
# Minimum temperature
Source: Interviews with company representatives.

Appendix A2d2.--South America. Operations of Spanish longliners off South America, 1996

Vessel*	Ports			Atlantic Grounds		Pacific grounds	Bait	Trip length
	Home	S. America	Africa	S. America	Africa			Months
Alicante	Vigo	Montevideo	Walvis Bay	Brazil/Urg.#	10°-25°S	None	M/S	3-4
Arosa Primera	Vigo	Montevideo		Brazil/Urg.#	W. Africa	None	Sq/SM	2-3
Maicoa	Vigo	Monte./Ilo				Chile/Peru#	M/Sq	3-4
Maicoa I	Vigo	Ilo				Chile/Peru#		
Urugora	Vigo	Ilo				Chile/Peru#		
V. de la Fra.**	Vigo	Montevideo	Walvis Bay	Brazil/Urg.#	10°-25°S	None	M/S	3-4

* A complete list of Spanish longliners operating in the south Atlantic indicating the owner is detailed in appendix A2c5.
** Virgen de la Franqueira
# Outside the 200-mile zone
Port location:
Ilo: Peru
Montevideo: Uruguay
Vigo: Spain
Walvis Bay: Namibia
Bait:
M - Mackerel
S - Sardine
Sq - Squid
SM - Spanish mackerel
Source: Interviews with company representatives.

Appendix A2e1.--Brazil. Leasing contracts

Item	Amount
Revenue	Total export income**
Less Brazilian costs*	
Profit	
Brazilian share	10 percent of export revenue
Foreign share	Profit remaining after Brazilian share

* The costs with the exception of the fuel, bait, and foreign crew wages are usually (but not always) paid up front by the Brazilian partner.
** Unlike the Brazilian vessels, a very small part of the catch is sold locally.
Note: Most of the Brazilian companies rely on an agent to contract the foreign vessels and to take care of the legal complications and various difficulties associated with the foreign fishermen. One company leasing two Taiwan vessels reports that his Montevideo agent charged $100,000.
Source: Various Brazilian companies (Leal Santos, Kawai, Imaipesca, and Pescal)

Appendix A2e2.--Brazil. Representative crew contract on Brazilian-flag vessels, 1996

Individual	Portion of profit	Share
	Percent	
Owner	50	
Crew	50	
Captain		7.0
First mate		4.5
Second mate		3.5
Engineer		3.5
Ice workers		2.0
Ordinary crew		1.0-1.3*

* Depending on experience
** After expenses are deducted from sale of the catch.
Note: One share on an average 20-23 day trip might be worth about $400-450 in 1995-96.
Source: Demétrio Urbano de Araújo Neto, Director Social, SINPESCATRAESP, Santos, personal communications, April 19, 1996.

Appendix A2e3.--Brazil. Crew contracts on foreign-flag vessels operating from Rio Grande, 1995

Individual	Basic salary	Actual share
	Reales*	
Vessel complement		
Captain	500	4.8 times basic salary
Cook	330	3.3 times basic salary
Crew	300	3.0 times basic salary
Bonus*		
0-30 days	NA	-
31-90 days	NA	1.00 percent of the catch
91-120 days	NA	1.75 percent of the catch

* About US$1.
** The fishermen get a share of the catch if the entire crew completes the full voyage.
Note: Using the above calculation, fishermen in Rio Grande were averaging about $1,000 per month.
Source: Antonio B. Anderson Elles, President, and Carlos Roberto Silva Medeiros, Treasurer, Sindicato dos Pescadores de Rio Grande, personal communications, April 17, 1996.

Appendix B.--South America, Share of South Atlantic swordfish grounds

Country	South American*	South Atlantic**
	Percent	
Argentina	5.9	0.5
Brazil	89.4	7.6
Uruguay	4.7	0.4
Total	100.0	8.5

* Proportion in terms of area of the South America Atlantic swordfish grounds.
** Proportion in terms of area of the overall South Atlantic swordfish grounds.
Source: José Dias Neto and José Heriberto M. de Lima, "Technical considerations relevant for the allocation of catch quota for the south Atlantic swordfish stock," unpublished paper prepared in cooperation with a Brazilian working group under the framework of the SEGESP. The paper was prepared as a working document at a 1997 ICCAT meeting in João Pessoa, table 2.

Series C Appendices: Biological Information
Series C1: Size
Series C2: Age
Series C3: Feeding
Series C4: Maturation
Series C5: Genetics

Appendix C1a.--Brazil. Swordfish size ranges

Ocean area	Author	Measurement	Length	
			Range	Common
			Centimeters	
Pacific				
Eastern	Kume and Joseph, 1969	EFL	50-280	110-200
Northwest	Yabe, *et. al.*, 1959	*	55-265	120-180
	Beardsley, *et. al.*,1979	LJFL	80-280	130-215
Atlantic				
Northeast	Palko, *et. al.*, 1981	EFL	80-300	140-220
Northwest	Palko, *et. al.*, 1981	EFL	80-300	120-170
Tropical	Ovchimmikov, *et. al*, 1980	EFL	60-220	130-215
Southwest**	Amorim and Arfelli, 1984	EFL	73-278	100-180

* Inferior mandible to the placa hipural
** Southeastern and southern Brazil
Source: Source: Rogerio Menezes de Mello, "Analise de conteudos estomacais, intensidade de alimentação, idade e crescimento do espadarte, *Xiphias gladius* (Xiphioidei: Xiphiidae), no sul do Brasil," MS Thesis, (Universidade do Rio Grande: Rio Grande, Brazil, October, 1992), p. 75.

Appendix C1b.--Brazil. Swordfish average weights reported by the Japanese (leased) longline fleet, 1978-89

Year	Swordfish weights*
	Kilograms
1978	62
1979	69
1980	72
1981	64
1982	52
1983	52
1984	48
1985	50
1986	54
1987	63
1988	58
1989	51

* Average rates of individual fish longline fleet.
Note: Data entries estimated from graphic in source.
Source: Rogerio Menezes de Mello, Teodoro Vaske Jr., and Jorge P. Castello, "Pesqueria de atunes y pez espada por la flota arrendada de Rio Grande, Brazil," *Frente Marítimo*, Vol. 14, Sec. A, 1993, p. 131.

Appendix C2.--Brazil* and Uruguay. Swordfish catch at various ages, 1978-91

Age	Year													
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Years	Units unknown													
0	34	39	132	83	101	55	1,182	453	181	54	62	342	-	-
1	205	381	616	841	1,333	1,119	5,543	3,938	2,153	1,441	1,135	1,020	2	6
2	695	1,284	2,317	2,330	5,703	7,758	13,681	10,782	5,254	5,890	5,995	3,973	706	443
3	602	1,463	3,861	2,254	5,382	7,785	14,607	8,070	7,839	6,053	8,980	8,069	3,532	1,717
4	677	1,370	4,243	1,918	4,695	5,167	8,277	6,189	5,263	3,285	5,793	6,041	7,870	5,053
5+	1,385	3,071	10,561	4,511	8,814	10,326	8,774	6,290	5,176	3,368	7,037	4,381	11,898	6,699
Total	3,598	7,608	21,730	11,937	26,028	32,210	52,064	35,722	25,866	20,091	29,002	23,826	24,008	13,918

* Includes the Japanese vessels leased by Brazilian companies.
Source: ICCAT, "SCRS tables," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 222. [189-236]

Appendix C3a.--Brazil. Swordfish stomach contents off southern Brazil, 1990-91

Species		IRI*	Stomachs		Contents			
English	Scientific		Containing	Proportion	Items	Proportion	Weight	Proportion
		Ratio	Number	Percent	Number	Percent	Kg	Percent
Argentine squid	Illex argentinus	1,416	53	28	340	32	12.9	18
Flying squid	Ommastrephidae**	689	49	26	100	9	12.0	17
Various bony fish	Teleosteo n.i.	684	55	29	171	16	5.2	7
Bass	Synagrops sp.	230	32	17	81	7	4.2	6
???	Chiroteuthis veranyi	131	34	18	76	7	0.1	Negl
Mackerel	Scomber japonicus	96	26	14	30	3	2.9	4
Flying squid	Ommastrephes bartrani	56	26	14	33	3	0.7	1
Filefish	Aluterus sp.	46	8	4	16	2	6.6	9
Others***	-	-	-	-	-	21	-	38
Total	—	-	283***	150	847	100	44.6	100

* Relative importance index
** Type A
*** Primarily Thysan??????
**** Total number of stomachs with contents
Source: Rogerio Menezes de Mello, "Analise de conteudos estomacais, intensidade de alimentação, idade e crescimento do espadarte, *Xiphias gladius* (Xiphioidei: Xiphiidae), no sul do Brasil," MS Thesis, (Universidade do Rio Grande: Rio Grande, Brazil, October, 1992), p. 65.

Appendix C3b.--Brazil. Swordfish male and female feeding patterns off southern Brazil, 1990-91

Prey item	Number		Quantity*	
	Male	Female	Male	Female
	Percent			
Cephalopods	79.2	77.7	38.0	55.8
Finfish	18.8	20.8	61.8	44.1
Crustaceans	2.1	1.4	0.3	0.1

Note: Number of samples - 96 males and 422 females
Total quantity of contents 4.6 kg (males) and 32.6 kg (females)
Source: Rogerio Menezes de Mello, "Analise de conteudos estomacais, intensidade de alimentação, idade e crescimento do espadarte, *Xiphias gladius* (Xiphioidei: Xiphiidae), no sul do Brasil," MS Thesis, (Universidade do Rio Grande: Rio Grande, Brazil, October, 1992), p. 68.

Appendix C3c.--Brazil. Swordfish feeding behavior off southern Brazil, 1990-91

Condition	????	Quantity
	?????	Kilograms
Season		
Autumn	1.8	0.33
Winter	2.0	0.47
Spring	1.6	0.25
Summer	NA	NA
Moon phases		
New	1.7	0.29
Second	1.8	0.23
Third	1.9	0.42
Full	2.0	0.35
Depth		
400-800 m	2.1	0.43
800-1,500 m	2.0	0.42
1,500-2,500 m	1.8	0.36
2,500m-3,500 m	1.6	0.30
Fish size		
75-110 cm	2.3	0.37
110-130 cm	2.0	0.30
130-170 cm	1.8	0.38
>170 cm	1.6	0.56
Sex		
Male	1.8	0.40
Female	1.8	0.23

Source: Rogerio Menezes de Mello, "Analise de conteudos estomacais, intensidade de alimentação, idade e crescimento do espadarte, *Xiphias gladius* (Xiphioidei: Xiphiidae), no sul do Brasil," MS Thesis, (Universidade do Rio Grande: Rio Grande, Brazil, October, 1992), p. 70.

Appendix C4.--Brazil. Level of gonadal maturation by season and area, 1974-76

Quarter	Dates	Area	Gonadal maturation level*					
			Immature	Developing	Initial	Advanced	Spawning	Repose
			Percent					
1	3/75	20°53′-27°30′S						
	1-2/77	40°-46°44′W	15.6	21.9	28.1	6.3	21.9	5.3
2	6/74	26°30′-30°55′S						
	7/77	46°25′-48°30′W	6.7	43.3	50.0	-	-	-
3	7/76	25°45′-29°20′S						
		45°20′-47°45′W	-	86.4	13.6	-	-	-
4	10/74	22°15′24°30′S						
		43°-44°18′W	----------100----------			-	-	-

*

Note: Indices developed by V.V. Ovchinnikov, "Swordfish and billfishes in the Atlantic Ocean," *Atlantic Scientific Research Institute of Fisheries and Oceanography*, 1970.

Source: A. Ferreira Amorim and C.A. Arfelli, "Reproducción del pez espada (*Xiphias gladius, L.* 1758) en el sudeste y sur del Brazil," *Collective Volume of Scientific Papers*, Vol. IXX, 1979, SCRS/79/43 (ICCAT: Madrid, 1979), p. 626.

Appendix C5a.--World. Worldwide swordfish haplotypes frequencies.

Location	Haplotypes			Total
	Alpha	Beta	Theta	
North Atlantic	63	36	23	122
South Atlantic	9	13	1	23
Mediterranean	32	15	29	76
North Pacific	2	24	-	26
Total	106	88	53	247

Source: Jaime R. Alvarado Bremer, Jaime Mejuto, Thomas W. Grieg, Bert Ely, "Global Population structure of the swordfish (*Xiphias gladius* L.) as revealed by analysis of the mitochondrial DNA control region." Journal of Experimental Marine Biology and Ecology, Vol. 197 (1996), p.306.

Appendix C5b.--World. Frequency distribution of mitochondrial DNA lineages by region.

Region	Haplotypes				Total
	Alpha	Beta	Theta A	Theta B	
North Atlantic	63	36	21	2	122
South Atlantic	39	69	4	-	112
Mediterranean	65	25	2	45	137
Indian	-	29	-	-	29
North Pacific	2	24	-	-	26
Total	169	183	27	47	426

Source: Jaime R. Alvarado Bremer, Jaime Mejuto, Bert Ely, "Genetic Population studies of swordfish: Lessons from the Atlantic Ocean and Mediterranean Sea." Poster presentation of the Second International Swordfish Conference, Turtle Bay, Oahu, Hawaii, March 5, 1997.

Series D Appendices: Effort and Yield
Series D1: Effort
Series D2: Yield

Appendix D1a.--South America. Fishing effort, 1971-95

Year	Brazil					Uruguay	Argentina
	Foreign*			National			
	RGSul**	RGNorte**	Santos	RGSul**	Santos		
			1,000 hooks				
1971					650.4		
1972					432.0		
1973					507.6		
1974					724.6		
1975					757.8		
1976					1,002.1		
1977	218.0	55.9			1,150.3		
1978	1,107.1	347.0			1,281.4		
1979	1.152.7	25.2			1,402.4		
1980	1,246.2	32.4			1,192.6		
1981	1,178.9	-			1,223.1		
1982	1,932.9	28.8		76.8	1,553.0	817.7	
1983	1,727.1	54.5		347.7	1,955.3	2,470.0	
1984	656.8	224.9		284.8	2,205.0	4,794.3	
1985	790.2	291.2		161.8	1,768.4	8,608.8	338.4
1986	1,567.2	441.4		201.4	1,845.5	1,371.0	318.6
1987	1,815.6	93.6		131.5	1,591.5	1,114.5	345.6
1988	1,883.2	60.5			1,964.0	607.1	320.4
1989					2,504.6		
1990					3,043.9		
1991					3,270.3		
1992			249.0		3,297.5		
1993			381.7		3,525.2		
1994	2,684.0		502.3		3,125.8		
1995	1,398.0		151.4		2,119.1		

* Foreign vessels leased by Brazilian companies
** The state of Rio Grande do Sul (RS) is the southern-most Brazilian state bordering on Uruguay. The principal port is Rio Grande. Rio Grande do Norte (RN) is the located it the northeast. It is northern part of Brazil's eastern-most protrusion into the Atlantic. The principal port is Natal.
Source: O. Mora, C. Arfelli, J.N. Antero, A.F. Amorim, and C. Gregorio, "Comparación de pesquerias de pez espada (*Xiphias gladius*) en el Atlantico sudoccidental," *Collective Volume of Scientific Papers*, SCRS/90/35, Vol. XXXV, No. 2, 1991, p. 442 and Carlos Arfelli, Instituto de Pesca, Santos, personal communications, July 16, 1996.

Appendix D1b--Brazil. Leased Japanese longline fishing effort in the Atlantic, 1977-95

Year	Vessels	Area*		Total
		I	II	
	Number	Number of hooks set		
1977	3	80,880	192,945	273,825
1978	3	918,283	535,785	1,454,068
1979	5	1,047,002	130,815	1,177,817
1980	5	1,225,202	53,340	1,278,542
1981	4	1,178,950	-	1,178,950
1982	6	2,179,716	61,200	2,240,916
1983	4	1,725,139	56,450	1,781,589
1984	3	656,810	425,321	1,082,131
1985	3	785,459	296,020	1,081,479
1986	6	1,565,167	684,219	2,249,386
1987	5	1,813,252	416,489	2,229,741
1988	5	1,878,430	548,485	2,426,915
1989	5	1,871,264	348,385	2,219,649
1990	5	1,716,775	475,935	2,192,710
1991	2	758,515	249,925	1,008,440
1992	1	193,365	88,150	281,515
1993	2	819,310	61,200	880,510
1994	2	944,500	163,940	1,108,440
1995	2	378,620	219,017	597,637
Total	23	21,736,639	5,007,621	26,744,260

* Area I: south of 25°S; Area II north of 25°S. See figure 43 in the Brazil chapter.
** Total number of vessel years deployed during 1977-91. The actual number of individual vessels, however is much smaller as many of these vessels were deployed in the fishery for several years. (For individual vessel data see appendix A2c3).
Note: 100 percent coverage
Source: CEPERG-IBAMA, Rio Grande, RS, Brazil as cited in J. Nelson Antero da Silva, "Tuna fishery in Brazil by leased Japanese longliner fleet from 1977 to 1991," *ICCAT Collective Volume of Scientific Papers*, Report of the Second ICCAT Billfish Workshop, Miami, Florida, July 22-29, 1992 (ICCAT: Madrid, 1994), p. 185 and J. Nelson Antero da Silva, personal communications, June 26, 1996.

Appendix D1c.--Brazil. Leased Japanese longline fishing effort and catch in the Atlantic, 1977-95

Year	Vessels	Effort		Total	Species*								
		Time	Gear	catch	BFT	YFT	ALB	BET	SWO	SAI	WHM	BUM	SKJ
	Number	Days	1,000 hooks		Metric tons (live weight)								
1977	3	136	274	498	Negl	46	55	65	12	-	227	-	93
1978	3	729	1,454	1,804	14	378	363	466	154	32	146	25	227
1979	5	637	1,178	1,584	10	381	217	405	200	26	112	4	229
1980	5	730	1,279	1,667	2	283	204	393	410	12	26	9	329
1981	4	665	1,179	1,902	3	727	187	341	223	Negl	4	5	411
1982	6	1,156	2,241	2,816	3	582	537	464	391	4	56	14	761
1983	4	790	1,782	2,361	1	505	472	378	283	7	25	15	675
1984	3	474	1,082	1,311	Negl	132	280	522	122	1	8	20	227
1985	3	472	1,081	1,489	1	276	226	364	227	2	37	24	333
1986	6	1,121	2,249	2,662	2	676	436	789	304	2	39	28	387
1987	5	1,038	2,230	2,422	2	409	262	691	511	4	31	26	485
1988	5	1,115	2,427	2,730	1	476	328	885	470	6	35	46	484
1989	5	888	2,193	1,998	2	634	372	471	241	1	31	29	216
1990	5	946	2,193	2,166	1	122	356	534	679	1	41	31	401
1991	2	420	1,008	1,017	Negl	207	198	237	122	Negl	22	18	212
1992	1				-	142P	61P	59P	33P				
1993	2				-	255P	246P	203P	62P				
1994	2	433	1,108	914	Negl	286P	110P	162P	109				
1995		256	598	504					53				
Total	69	12,006	25,556	29,845	42	6,517	4,910	7,429	4,606	98	840	294	5,470

* Species:
BFT - Bluefin tuna
YFT - Yellowfin tuna
ALB - Albacore tuna
BET - Bigeye tuna
SWO - Swordfish
SAI - Sailfish
WHM - White marlin
BUM - Blue marlin
SKJ - Skipjack
P - Preliminary
Source: IBAMA-CEPERG, Rio Grande, RS, Brazil as cited in J. Nelson Antero da Silva, "Tuna fishery in Brazil by leased Japanese longliner fleet from 1977 to 1991," *ICCAT Collective Volume of Scientific Papers*, Report of the Second ICCAT Billfish Workshop, Miami, Florida, July 22-29, 1992 (ICCAT: Madrid, 1994), p. 185 (1977-91 data) and Instituto de Pesca (192-95 data).

Appendix D1d.--Brazil. Domestic and foreign longline fishing effort, 1971-95

Year	Leased			Domestic			All fleets		
	South	North	Total	South	North	Total	South	North	Total
					1,000 Hooks				
1971	-	-	-	650.4	-	650.4	650.4	-	650.4
1972	-	-	-	432.0	-	432.0	432.0	-	432.0
1973	-	-	-	507.6	-	507.6	507.6	-	507.6
1974	-	-	-	724.6	-	724.6	724.6	-	724.6
1975	-	-	-	757.8	-	757.8	757.8	-	757.8
1976	-	-	-	1,002.1	-	1,002.1	1,002.1	-	1,002.1
1977	80.9	192.9	273.8	1,007.5	55.9	1,063.4	1,088.4	248.8	1,337.2
1978	918.3	535.8	1,454.1	1,402.4	347.0	1,749.4	2,320.7	882.8	3,203.5
1979	1,047.0	130.8	1,177.8	1,294.6	25.2	1,319.8	2,341.6	156.0	2,497.6
1980	1,225.2	53.3	1,278.5	1,192.6	32.4	1,225.0	2,417.8	85.7	2,503.5
1981	1,179.0	-	1,179.0	1,201.1	-	1,201.1	2,380.1	-	2,380.1
1982	2,179.7	61.2	2,240.9	1,649.7	28.8	1,678.5	3,829.4	90.0	3,919.4
1983	1,725.1	56.5	1,781.6	2,303.2	54.5	2,357.7	4,028.3	111.0	4,039.3
1984	656.8	425.3	1,082.1	2,489.8	224.9	2,714.7	3,146.6	650.2	3,796.8
1985	785.5	296.0	1,081.5	1,666.6	291.2	1,957.8	2,452.1	587.2	3,039.3
1986	1,565.2	684.2	2,249.4	1,770.2	441.4	2,211.6	3,335.4	1,125.6	4,461.0
1987	1,813.3	416.5	2,229.7	1,348.3	93.6	1,441.9	3,161.6	510.1	3,671.7
1988	1,878.4	548.5	2,426.9	1,795.1	60.5	1,855.6	3,673.5	609.0	4,282.5
1989	1,871.3	348.4	2,219.6						
1990	1,716.8	475.9	2,192.7						
1991	758.5	249.9	1,008.4						
1992									
1993									
1994	3,200.0E	2,300.0E	5,500.0E	3,200.0E	300.0E	3,500.0E	6,400.0E	2,600.0E	9,000.0E
1995				2,100.0E					

E - Estimated

Source: Appendices D1a (1971-88 data) and Dr. Alberto Amorim, Instituto de Pesca, Santos, personal communications, April 20, 1996 (1989-95 data).

Appendix D1e.--Brazil. Operations of leased longliners from Rio Grande, RS, 1977-95

Country	Years	Average effort	Crews	
			Brazilian	Foreign
		Hooks/day	Number	
Japan	1977-95	2,132	5	16#
Korea	1994-95	2,178	6	19
Taiwan	1991-94	2,841	6	19

Mostly Japanese
Source: Jose Nelson Antero da Silva, IBAMA/CEPERG, personal communications, May 15, 1996.

Appendix D2a.--Atlantic. Swordfish yield summary, 1997

Factor	Atlantic swordfish	
	North	South
Quantitative (metric ton) data		
Maximum sustainable yield (MSY)	13,000 t (5,300-16,500 t)*	14,200 t (5,200-16,900 t)*
Preliminary 1996 yield	14,763 t	17,983 t
1996 replacement yield	11,360 t (7,120-16,710 t)	14,620 t (8,400-17,140 t)
Ratios		
Relative biomass (B_{1996}/B_{MSY})*	0.58 (0.41-1.04)	0.99 (0.82-1.18)
Relative fishing mortality		
F_{1995}/F_{MSY}*	2.05 (1.07-3.82)	1.24 (0.94-1.93)
F_{1995}/F_{max}**	2.4	Not estimated****
$F_{1995}/F_{0.1}$**	3.5	Not estimated****
Other		
Management measures in effect	25 kg minimum size and country specific quotas	Limit catch to 1993 or 1994 levels

kg - kilograms
t - metric tons
* Base case production model results based on 1950-95 catch data.
** Base case VPA results based on catch data available through 1995.
*** 80 percent confidence intervals are shown.
**** Production model results do not provide basis for these estimates.
Source: ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics*, (COM/97/17) Madrid, October 20-24, 1997, p. 82.

Appendix D2b.--Brazil. Domestic longline fleet effort and yield data, 1977-84

Year	Effort	Albacore		Bigeye		Yellowfin		Swordfish		Total	
		Catch	Yield*	Catch	Yield*	Catch	Yield*	Catch	Yield*	Catch	Yield*
	Million hooks	M. tons	Kg/100h	M. tons	Kg/100h	M. tons	Kg/100h	M. tons	Kg/100h	M. tons	Kg/100h
1976	1.09	156.8	14.5	111.8	10.3	424.3	39.1	371.8	34.3	1,421.4	131.0
1977	1.25	157.0	12.6	150.0	12.0	368.0	29.4	330.0	26.4	1,423.8	113.9
1978	1.28	65.0	5.1	76.0	5.9	331.0	25.8	138.0	10.7	872.0	68.1
1979	1.29	151.0	11.7	167.0	12.9	553.0	42.7	213.0	16.5	1,361.0	105.1
1980	1.19	184.9	15.2	174.0	14.6	236.2	19.8	1,125.0	94.3	2,150.0	180.3
1981	1.22	63.1	5.2	102.4	8.4	459.5	37.6	405.0	33.1	1,140.4	93.2
1982	1.63	173.1	10.6	188.1	11.5	322.2	19.8	613.0	37.6	1,448.9	88.9
1983	2.30	191.2	8.3	127.4	5.5	470.7	20.4	470.7	20.4	1,458.2	63.3
1984	2.58	171.0	6.6	135.7	5.3	341.3	13.2	341.3	13.2	1,380.6	53.6

* Hook rate, kilograms per 100 hooks
Source: PDP/SUDEPE, Instituto de Pesca (Sao Paulo) in J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), p. 235.

Appendix D2c.--Brazil. Leased (Japanese) longline fleet effort and yield data, 1977-84

Year	Effort	Albacore		Bigeye		Yellowfin		Swordfish		Total	
		Catch	Yield*	Catch	Yield*	Catch	Yield*	Catch	Yield*	Catch	Yield*
	Million hooks	M. tons	Kg/100h	M. tons	Kg/100h	M. tons	Kg/100h	M. tons	Kg/100h	M. tons	Kg/100h
1977	0.27	55.0	20.1	65.6	23.9	45.2	16.5	12.6	4.6	470.4	171.8
1978	1.73	374.2	22.0	481.0	27.7	450.0	26.0	180.4	10.4	1,998.4	115.3
1979	1.17	215.6	18.3	401.2	34.2	378.7	32.2	201.6	17.2	1,508.7	128.4
1980	1.28	204.1	15.9	392.6	30.7	283.3	22.2	409.5	32.0	1,666.7	130.4
1981	1.18	187.1	15.9	341.4	28.9	727.5	61.7	222.8	18.9	1,902.0	161.3
1982	2.24	537.1	24.0	464.0	20.7	582.1	26.0	390.8	17.4	2,816.3	125.7
1983	1.78	472.2	26.5	378.2	21.2	504.7	28.3	282.8	15.9	2,263.2	127.0
1984	1.08	280.0	25.9	521.5	48.2	131.6	12.2	121.5	11.2	1,311.6	121.2

* Hook rate, kilograms per 100 hooks
Source: PDP/SUDEPE, in J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), p. 234.

Appendix D2d1.--Brazil. Activity summary of leased vessels based in Rio Grande, RS, on all Atlantic ground, 1977-95

Fleet	Years	Effort	Swordfish catch	CPUE*	Proportion swordfish
		1,000 hooks	Metric tons	Kg/1,000 hooks	Percent
Japan	1977-95	26,744	4,360.6	173	15
Korea	1994-95	1,424	52.1	37	7
Taiwan	1991-94	16,811	1.755.3	104	20

* CPUE - Catch-per-unit effort
Source: Jose Nelson Antero da Silva, IBAMA/CEPERG, personal communications, May 15, 1996.

Appendix D2d2.--Brazil. Activity summary of leased vessels based in Rio Grande, RS, on grounds south of 15°S along the Brazilian coast, 1977-95

Fleet	Years	Effort	Swordfish catch	CPUE*	Proportion	
					Total**	South***
		1,000 hooks	Metric tons	Kg/1,000 hooks	Percent	
Japan	1977-95	22,393	4,285.3	191	16	93
Korea	1994-95	1,152	42.1	37	8	81
Taiwan	1991-94	8,902	1,493.0	168	29	85

* CPUE - Catch-per-unit effort
** Proportion of swordfish in total longline catch
*** Proportion of swordfish catch taken on southern grounds (south of 15°S).
Source: Jose Nelson Antero da Silva, IBAMA/CEPERG, personal communications, May 15, 1996.

Appendix D2e.--Brazil. Leased Japanese longline catch per unit of elective effort, 1977-95

Year	Species				Total
	Tuna	Swordfish	Marlins	Others	
	Kilograms/1,000 hooks				
1977	608	44	828	339	1,819
1978	840	106	139	156	1,241
1979	860	170	120	195	1,345
1980	690	320	37	257	1,304
1981	1,068	189	8	348	1,613
1982	708	175	35	340	1,257
1983	761	159	26	379	1,325
1984	862	112	27	210	1,211
1985	801	210	57	308	1,376
1986	846	135	31	172	1,184
1987	612	229	27	217	1,086
1988	696	194	35	200	1,125
1989	667	109	28	97	901
1990	462	310	33	183	988
1991	637	121	40	210	1,008
1992	932	118	32	127	1,208
1993	903	97	24	251	1,275
1994	503	98	16	207	824
1995	557	89	42	155	843
Average	733	173	40	228	1,171

Source: IBAMA-CEPERG, Rio Grande, RS, Brazil as cited in J. Nelson Antero da Silva, "Tuna fishery in Brazil by leased Japanese longliner fleet from 1977 to 1991," *ICCAT Collective Volume of Scientific Papers*, Report of the Second ICCAT Billfish Workshop, Miami, Florida, July 22-29, 1992 (ICCAT: Madrid, 1994), p. 185 and J. Nelson Antero da Silva, personal communications, June 26, 1996.

Appendix D2f.--Brazil. Swordfish yields (CPUE) reported by leased vessels*, 1977-95

Year	Effort	Catch		Yield	
		Individuals	Quantity	Individuals	Quantity
	1,000 hooks	Number	Metric tons	Fish/Kg per1,000 hooks	
1977	274	144	13	0.53	NM
1978	1,454	2,464	180	1.69	0.12
1979	1,178	2,883	202	2.45	0.17
1980	1,279	5,740	410	4.48	0.32
1981	1,179	3,412	222	2.89	0.19
1982	2,241	7,368	391	3.29	0.17
1983	1,782	5,412	283	3.04	0.16
1984	1,082	2,512	122	2.32	0.11
1985	1,081	4,587	227	4.24	0.21
1986	2,249	5,641	304	2.51	0.14
1987	2,230	7,988	511	3.58	0.23
1988	2,427	8,282	470	3.40	0.19
1989	2,193	4,870	241	2.22	0.11
1990	2,193	11,489	679	5.24	0.31
1991	1,008	2,341	122	2.32	0.12
1992	NA	1,045	55		
1993	NA	1,401	77		
1994	5,500E	4,596	257	0.84	0.05
1995	NA	3,034	146		
1996					

Note: The above yields are only the swordfish portion of a multiple-species fishery.
E - Estimated
NA - Not available
P - Preliminary
* Until 1991, almost all the leased vessels were Japanese (appendix A1c).
Source: Appendices D1d (1977-91 data) and Dr. Alberto Amorim and Dr. Carlos Arfelli, Instituto de Pesca, Santos, personal communications, April 20 and July 16, 1996 (1992-95 data).

Appendix D2g.--Brazil. Catch and effort for leased vessels operating from Rio Grande, RS, 1994-95

Year/ Fleet	Effort		Swordfish		Total catch*	Proportion swordfish
	Hooks	Days	Catch*	Yield		
	1,000 hooks	Number	Metric tons	Kg/1,00 hooks	Metric tons	Percent
1994						
Japan	1,108	433	108.8	0.10	914.1	12
Korea	624	293	19.0	0.03	365.1	5
Taiwan	952	307	51.1	0.05	340.8	15
Subtotal	2,684	1,033	178.9	0.18	1,620.0	11
1995						
Japan	598	256	53.1	0.09	503.5	11
Korea	800	361	33.1	0.04	404.7	8
Subtotal	1,398	617	86.2	0.13	908.2	9

Source: Jose Nelson Antero da Silva, IBAMA/CEPERG, personal communications, May 15, 1996.

Appendix D2h1.--Brazil. Operation of foreign leased longliners primarily off northeastern Brazil, August 1997-January 1998

Species	Number				Weight			
	Fish	Group	Total	CPUE	Weight	Group	Total	CPUE
	Number	Percent		Fish	1,000 Kg	Percent	Weight	
Tunas								
Yellowfin	729	38.4	8.2	0.44	103.0	73.6	21.9	62.8
Bigeye	366	19.3	4.1	0.22	13.0	9.3	2.8	7.9
Albacore	804	42.3	9.1	0.49	24.0	17.1	5.1	14.6
Total, tunas	1,899	100.0	21.4	1.16	140.0	100.0	29.8	85.4
Billfish								
Swordfish	4,962	89.4	56.0	3.03	254.5	94.8	56.3	161.3
Sailfish	195	3.5	2.2	0.12	2.9	1.0	0.6	1.8
Marlin								
White	199	3.6	2.2	0.12	7.9	2.8	1.7	4.8
Black	197	3.5	2.2	0.12	3.8	1.4	0.8	2.3
Total, billfish	5,553	100.0	62.7	3.39	279.1	100.0	59.4	170.2
Other finfish	139	-	1.7	0.08	10.5	-	2.2	6.4
Sharks**	1,270	-	14.2	0.77	40.3	-	8.6	24.6
Total	8,861	-	100.0	5.40	469.8	-	100.0	286.5

NA - Not available
* Artisanal longliners
** Includes the fins
Source: Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pesca: Universidade Federal Rural de Pernambuco, 1998), p. 26.

Appendix D2h2.--Brazil. Operation of artisanal longliners primarily off northeastern Brazil, August 1997-January 1998

Species	Number				Weight			
	Fish	Group	Total	CPUE	Weight	Group	Total	CPUE
	Number	Percent		Fish	M. tons	Percent		Weight
Tunas								
Yellowfin	77	34.7	9.5	0.41	-	-	-	-
Bigeye	131	59.0	16.1	0.70	7.3	78.8	27.2	39.3
Albacore	14	6.3	1.7	0.08	2.0	21.2	7.3	10.6
Total, tunas	222	100.0	27.3	1.19	9.3	100.0	34.5	50.0
Billfish								
Swordfish	374	81.5	45.9	2.00	12.8	87.8	47.5	68.8
Sailfish	81	17.6	10.0	0.43	1.3	8.7	4.7	6.8
Marlin								
White	3	0.7	0.4	0.02	0.3	2.1	1.1	1.6
Black	1	0.2	0.1	0.01	0.2	1.5	0.8	1.1
Total, billfish	459	100.0	56.4	2.46	14.6	100.0	54.2	78.4
Other finfish	49	-	6.0	0.26	0.8	-	2.9	4.2
Sharks**	84	-	10.3	0.45	2.3	-	8.4	12.2
Total	814	-	100.0	4.36	27.0	-	100.0	144.6

NA - Not available
* Artisanal longliners
** Includes the fins
Source: Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pesca: Universidade Federal Rural de Pernambuco, 1998), p. 34.

Appendix D3a.--Brazil. Longline methods, 1995-96

Activity/ gear	Method	
	U.S. Style*	Japanese-style
Main line		
Material	Monofilament	Steel and twisted nylon
Length	80 km	NA##
Hooks per set		
Range	300-1,200	900-1,700
Average	802	1,672
Sets		
Hook depth	40-50 meters	70-120mmeters
Time	6-9 pm	NA###
Target	Swordfish	Multi-species
Bait	Squid**#	Squid, mackerel, and sardines**
Light sticks	Yes	No

* Also referred to as American or Florida-style methods.
** Bait species
Chub mackerel - *Scomber japonicus*
Sardines - *Sardinella brasiliensis*
Squid - *Illex argentinus*
Occasionally tinted
Not in source, but believed usually much longer than the U.S. lines
Believed to be similar to the U.S. sets.
Source: Tatiana Neves and Fabio Olmos, "Albatross mortality in fisheries off the coast of Brazil," Chapter 17
in G. Roberstson and R. Gales, ed. *The Albatross Biology and Conservation*
(Surrey Beatty & Sons: Clipping Norton, 1997), p. 215.

Appendix D3b.--Brazil. Technical data on monofilament gear used by artisanal and leased commercial longliners, 1997-98

Item	Quantity		Length		Diameter	Size
	Art*	Leased	Art*	Leased		
	Number		Kilometers/Meters*		Millimeters	
Mainline (mestra)	1	1	12km	40km	4.0	
Ganglion line (bura)	300	1,200	12m	20m	1.8	
Sekyama**	300	1,200	3m	5m	1.8	
Hooks	300	1,200	-	-	-	8/0-16/0
Buoys	50	200	-	-	-	
Buoy cable	50	200	20m	NA	1.8	
Signal buoy	4	16	3m	3m	-	

NA - Not available
* Artisanal longliners
** A piece of line between the snap and the spindle
Source: Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pesca: Universidade Federal Rural de Pernambuco, 1998), p. 26.

Appendix D4a1.--Brazil. Average earnings per trip of a foreign leased longliner off northeastern Brazil, August 1997-January 1998

Species	Number	Weight	Price	Earnings
	Fish	Metric tons	R$/Kg*	Reales*
Tunas				
Yellowfin	42.9	6.1	NA	NA
Bigeye	21.5	0.8	2.90	2,215
Albacore	47.3	1.4	2.60	3,666
Total, tunas	111.7	2.2	2.71	5,881
Billfish				
Swordfish	291.9	15.6	3.00	46,676
Sailfish	11.5	0.2	1.53	260
Marlin				
White	11.7	0.5	1.66	768
Black	11.6	0.2	1.38	310
Total, billfish	326.6	16.4	2.92	48,014
Other finfish	8.2	0.6	1.53	940
Sharks**	74.7	2.4	1.02	2,407
Total	521.2	21.6	2.65	57,244

* R$ (reales) in 1997 equaled about US$0.95.
** Includes the fins.
Source: Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pesca: Universidade Federal Rural de Pernambuco, 1998), p. 31.

Appendix D4a2.--Brazil. Average earnings per trip of a artisanal longliner off northeastern Brazil, August 1997-January 1998

Species	Number	Weight	Price	Earnings
	Fish	Metric tons	R$/Kg*	Reales*
Tunas				
Yellowfin	6.4	NA	NA	NA
Bigeye	10.9	0.6	2.90	1,770
Albacore	1.2	0.2	2.60	428
Total, tunas	18.5	0.8	2.84	2,198
Billfish				
Swordfish	31.2	1.1	3.00	3,205
Sailfish	6.8	0.1	1.53	161
Marlin				
White	0.3	Negl	1.66	42
Black	0.1	Negl	1.38	25
Total, billfish	38.3	1.2	2.82	3,433
Other finfish	4.1	0.1	1.53	99
Sharks**	7.0	0.2	1.02	193
Total	67.8	2.2	2.64	5,923

* R$ (reales) in 1997 equaled about US$0.95.
** Includes the fins.
Source: Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pesca: Universidade Federal Rural de Pernambuco, 1998), p. 35.

Appendix D4b1.--Brazil. Average costs of provisions for a leased foreign longliner operating with monofilament on a 25 day trips, August 1997 -January 1998

Item	Quantity	Units	Cost	
			Per unit	Total
	Number		Reales*	
Ice	50,000	kilogram	0.05	2,550
Diesel	40,000	liter	0.40	14,000
Food	-	kg	-	1,800
Light sticks	-	unit	0.85	-
Bait (squid)	500	kilogram	1.80	7,200
Other	-	-	-	1,600
Total	-	-	-	27,100

* For much of 1996-98 the real was traded for US$0.90-1.00. The Government devalued the real in January 1999 and then let it float. It subsequently fell to as low as US$0.50, but is unclear as of February 1999 at what level the real will eventually trade.
Note: Labor costs are included, presumably because the fishermen are paid as a share of the catch.
Source: Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pesca: Universidade Federal Rural de Pernambuco, 1998), p. 31.

Appendix D4b2.--Brazil. Average costs of provisions for an artisanal longliner operating with monofilament on a 5 day trip, 1998

Item	Quantity	Units	Cost	
			Per unit	Total
	Number		Reales*	
Ice	3,000	kilogram	0.05	150
Diesel	400	liter	0.40	160
Food	-	-	-	1,800
Light sticks	800	unit	0.85	680
Bait (squid)	500	kilogram	1.80	900
Other	-	-	-	160
Total	-	-	-	2,250

* For much of 1996-98 the real was traded for US$0.90-1.00. The Government devalued the real in January 1999 and then let it float. It subsequently fell to as low as US$0.50, but is unclear as of February 1999 at what level the real will eventually trade.
Source: Humberto Gomes Hazin and Fábio Hissa Vieira Hazin, *Análise da Viabilidade Económica do Emprego do Espinel Monofilamento em Pequenas Embarcaçoes Artesanais da Frota Nordestina* (Departamento de Pesca: Universidade Federal Rural de Pernambuco, 1998), p. 36.

Series E Appendices: Catch
- Series E1: Overall catch
- Series E2: Longline catch
- Series E3: Swordfish catch
- Series E4: Tuna, billfish, and shark catch
- Series E5: Bycatch
- Series E6: Catch regulations

Appendix E1.--Brazil. Fisheries catch, 1980-96

Year	Catch
	1,000 Metric tons
1980	806.2
1981	808.9
1982	827.4
1983	875.9
1984	954.3
1985	966.8
1986	957.6F
1987	948.0
1988	830.1
1989	850.0
1990	802.9F
1991	776.7F
1992	760.3F
1993	749.7F
1994	789.2F
1995	770.8F
1996	798.7F

F - FAO estimate
Note: The fact that FAO has had to estimate Brazilian catches in the 1990s is one reflection of the weakness of the national fisheries statistics program.
Source: FAO, *Yearbook of Fishery Statistics*, various years.

Appendix E2a.--Brazil. Longline catch*, 1979-95

Species/ fleet	Year																
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
	Metric tons																
Billfish other than swordfish																	
Brazilian	83	105	80	83	108	142	196	347	201	243	325	272	354	166	140	131	135
Leased	142	47	10	78	47	28	63	69	61	85	61	73	147	451	666	100	234
Subtotal	225	152	90	161	155	170	259	416	262	328	387	345	501	617	805	231	369
Swordfish																	
Brazilian	320	1,169	431	627	498	346	342	457	444	693	926	1,024	721	624	619	956	1,168
Leased	200	409	223	391	283	122	227	304	511	470	241	679	590	1,979	1,602	602	572
Subtotal	520	1,578	654	1,018	781	468	569	761	955	1,162	1,168	1,703	1,311	2,603	2,221	1,558	1,640
Tunas																	
Albacore																	
Brazilian	164	186	69	191	205	189	71	68	63	66	61	129	58	92	54	68	91
Leased	217	204	187	537	472	280	226	436	262	327	372	356	1,022	2,629	4,533	767	633
Subtotal	381	390	256	728	677	469	297	504	325	394	434	485	1,080	2,721	4,587	835	724
Bigeye																	
Brazilian	242	195	114	228	136	133	46	73	65	61	41	57	43	29	46	37	94
Leased	405	393	341	464	378	522	364	789	691	885	471	534	307	759	1,511	557	1,841
Subtotal	647	588	455	692	514	655	410	862	756	946	512	591	350	788	1,557	594	1,935
Yellowfin																	
Brazilian	695	238	432	353	382	351	240**	381	243	422	492	532	248	258	396	233	98
Leased	381	283	727	582	505	132	276	676	409	477	634	122	334	969	1,627	918	1,214
Subtotal	1,076	521	1,159	935	887	483	516	1,057	652	899	1,126	655	582	1,226	2,023	1,151	1,312
Other***																	
Brazilian	4	2	1	1	-	1	1	5	7	4	4	11	40	61	48	27	4
Leased	10	2	3	3	2	6	4	10	3	3	7	10	36	214	304	39	69
Subtotal	14	4	4	4	2	7	5	15	10	7	11	21	76	275	352	65	73
Fleet																	
Brazilian	1,508	1,895	1,127	1,483	1,329	1,162	896	1,331	1,023	1,489	1,849	2,025	1,463	1,230	1,302	1,451	1,590
Leased	1,358	1,338	1,491	2,055	1,687	1,090	1,160	2,284	1,937	2,247	1,788	1,774	2,436	7,001	10,243	2,983	4,563
Grand total	2,863	3,233	2,618	3,538	3,016	2,252	2,056	3,615	2,960	3,733	3,637	3,800	3,899	8,231	11,545	4,435	6,153

Note: Menses de Lima in his 1997 report suggests substantial changes in the historical data.
* Includes both the Brazilian and leased foreign longline fleet based in Santos.
** Includes minor amounts of albacore and bigeye.
*** Includes *Acanthocybium solanderi*
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 337 (1979-87 data); and J.H. Meneses de Lima, "National report of Brazil," for 1995 ICCAT meeting (1988-94 data); Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (Vol. I, Part II), (ICCAT: Madrid, 1997), p. 142.

Appendix E2b.--Brazil. Japanese leased longline catch of tuna and related species, 1977-91

Year	Species*									Total
	BFT	YFT	ALB	BET	SWO	SAI	WHM	BUM	OTH	
	Number of fish									
1977	27	1,200	2,088	1,446	144	----------	6,656	---------	4,075	15,636
1978	1,033	15,128	17,095	10,040	2,464	1,452	5,223	198	8,233	60,866
1979	1,336	16,578	11,068	8,963	2,883	1,190	4,061	29	7,872	53,980
1980	232	13,193	9,598	7,642	5,740	440	941	52	10,715	48,553
1981	386	37,773	11,512	10,568	3,412	11	187	26	13,995	77,870
1982	331	32,075	26,781	8,973	7,368	580	2,778	77	27,027	105,990
1983	53	27,146	27,296	8,651	5,412	425	952	79	20,263	90,277
1984	1	4,528	14,322	12,512	2,512	48	270	153	8,269	42,615
1985	8	10,132	11,366	9,930	4,587	96	1,548	216	11,550	49,433
1986	75	26,273	23,369	21,329	5,641	76	1,576	186	15,449	93,974
1987	135	20,816	14,012	16,129	7,988	147	1,119	168	21,042	81,556
1988	19	33,052	17,912	18,483	8,282	275	1,324	288	19,699	99,334
1989	271	28,180	19,851	10,200	4,870	51	1,198	208	8,609	73,438
1990	62	4,680	18,952	12,972	11,489	58	1,433	209	16,269	66,124
1991	37	8,700	10,424	5,276	2,341	18	785	113	7,497	35,191
Total	4,006	279,454	235,646	163,114	75,133	4,867	30,051	2,002	200,564	994,837

* Species:
- BFT - Bluefin tuna
- YFT - Yellowfin tuna
- ALB - Albacore tuna
- BET - Bigeye tuna
- SWO - Swordfish
- SAI - Sailfish
- WHM - White marlin
- BUM - Blue marlin
- OTH - Other

Source: CEPERG-IBAMA, Rio Grande, RS, Brazil as cited in J. Nelson Antero da Silva, "Tuna fishery in Brazil by leased Japanese longliner fleet from 1977 to 1991," *ICCAT Collective Volume of Scientific Papers*, Report of the Second ICCAT Billfish Workshop, Miami, Florida, July 22-29, 1992 (ICCAT: Madrid, 1994), p. 185.

Appendix E2c1.--Brazil. Catch composition of the Brazilian and leased longline fleets (excluding shark), 1992-95

Species	Fleet	Year			
		1992	1993	1994	1995*
			Metric tons		
Yellowfin	Brazilian	227	418	165	98
	Leased	970	1,100	919	1,214
Albacore	Brazilian	95	55	68	91
	Leased	2,615	3,545	767	633
Bigeye	Brazilian	29	54	39	94
	Leased	760	1,202	557	1,841
Swordfish	Brazilian	608	674	969	1,168
	Leased	1,979	1,339	602	572
Sailfish	Brazilian	30	51	34	32
	Leased	252	150	26	65
White marlin	Brazilian	117	79	73	60
	Leased	92	224	17	43
Blue marlin	Brazilian	14	19	21	43
	Leased	109	127	49	126
Other*	Brazilian	40	4	5	4
	Leased	227	204	32	69
Total	Brazilian	1,160	1,354	1,374	1,590
	Leased	7,004	7,891	2,969	4,563

* Preliminary
Source: Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (Vol. I, Part II), (ICCAT: Madrid, 1997), p. 142.

Appendix E2c2a.--Brazil. Catch composition of the Brazilian and leased longline fleets (including shark), 1992-95

Fleet/ species	Year			
	1992	1993	1994	1995*
		Metric tons		
Brazilian				
Billfish				
Sailfish	30	51	34	32
Marlin				
White	117	79	73	60
Blue	14	19	21	43
Shark	2,000	2,137	1,892	1,460
Swordfish	608	674	969	1,168
Tuna				
Yellowfin	227	418	165	98
Albacore	95	55	68	91
Bigeye	29	54	39	94
Other*	40	4	5	4
Total	3,160	3,491	3,266	3,050
Leased				
Billfish				
Marlin				
Blue	109	127	49	126
White	92	224	17	43
Sailfish	252	150	26	65
Shark	575	1,439	720	692
Swordfish	1,979	1,339	602	572
Tuna				
Albacore	2,615	3,545	767	633
Bigeye	760	1,202	557	1,841
Yellowfin	970	1,100	919	1,214
Other*	227	204	32	69
Total	7,579	9,330	3,571	5,255
Total	10,739	12,821	6,955	8,305

* Preliminary
Source: Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (Vol. I, Part II), (ICCAT: Madrid, 1997), pp. 142-143.

Appendix E2c2b.--Brazil. Catch composition of the Brazilian and leased longline fleets, 1992-95

Fleet/ species	Year 1992	1993	1994	1995*
	Percent			
Brazilian				
Billfish				
Sailfish	1	1	1	1
Marlin				
White	4	2	2	2
Blue	Negl	Negl	1	1
Shark	63	61	58	48
Swordfish	19	19	30	38
Tuna				
Yellowfin	7	12	5	3
Albacore	3	2	2	2
Bigeye	1	2	1	3
Other*	1	Negl	Negl	Negl
Total**	100	100	100	100
Leased				
Billfish				
Marlin				
Blue	1	1	1	2
White	1	2	Negl	1
Sailfish	3	2	1	1
Shark	7	15	20	13
Swordfish	26	14	17	11
Tuna				
Albacore	35	38	21	12
Bigeye	10	13	16	35
Yellowfin	13	12	26	23
Other*	3	2	1	1
Total**	100	100	100	100

* Preliminary
** Totals may not agree due to rounding
Source: Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (Vol. I, Part II), (ICCAT: Madrid, 1997), pp. 142-143.

Appendix E2c3.--Brazil. Japanese leased longline catch and yields, 1977-91

Catch/ yield	Area+	Total	Species*								
			BFT	YFT	ALB	BET	SWO	SAI	WHM	BUM	SKJ
Catch	I	23,655	39	5,081	4,282	4,764	4,020	16	329	111	5,014
(Tons**)	II	4,774	3	755	211	2,242	329	85	511	182	455
	Atlantic	28,428	41	5,836	4,493	7,007	4,349	101	839	293	5,469
Catch	I	868,820	3,825	260,954	227,250	110,491	69,145	736	12,464	499	183,456
(Number***)	II	126,017	181	18,500	8,396	52,623	5,988	4,131	17,587	1,503	17,108
	Atlantic	994,837	4,006	279,454	235,646	163,114	75,133	4,867	30,051	2,002	200,564
Yield	I	1,219	2	262	221	245	207	1	17	6	258
(CPUE#)	II	1,067	1	169	47	501	73	19	114	41	102
	Atlantic	1,190	2	244	188	294	182	4	35	12	229
Yield	I	44.8	0.2	13.5	11.7	5.7	3.6	0.0	0.6	0.0	9.5
(CPUE##)	II	28.1	0.1	4.1	1.9	11.8	1.3	0.9	3.9	0.3	3.8
	Atlantic	41.7	0.2	11.7	9.9	6.8	3.1	0.2	1.3	0.1	8.4

\+ Area I - South of 25°S
II - North of 25°S

* Species:
BFT - Bluefin tuna
YFT - Yellowfin tuna
ALB - Albacore tuna
BET - Bigeye tuna
SWO - Swordfish
SAI - Sailfish
WHM - White marlin
BUM - Blue marlin
OTH - Other

** Live weight in metric tons
*** Number of fish
# CPUE (kilograms per 1,000 hooks)
CPUE (number of fish per 1,000 hooks)

Source: IBAMA-CEPERG as cited in as cited in J. Nelson Antero da Silva, "Tuna fishery in Brazil by leased Japanese longliner fleet from 1977 to 1991," *ICCAT Collective Volume of Scientific Papers*, Report of the Second ICCAT Billfish Workshop, Miami, Florida, July 22-29, 1992 (ICCAT: Madrid, 1994), p. 186.

Appendix E2c4.--Brazil. Japanese (leased vessels) longline catch, by species#, 1977-89

Species	Area		Total
	Southern*	Northern**	
	Percent		
Marlins			
Blue	1	4	2
White	2	13	3
Tunas			
Albacore	18	5	15
Bigeye	22	44	25
Bluefin	Negl.	-	Negl.
Yellowfin	23	17	22
Sailfish	-	3	1
Swordfish	15	6	14
Sharks#	21	9	19
Total##	100	100	100

* South of 25°S
** North of 25°S
# Refers to the catch retained only and not species discarded. Also the fishermen reportedly fin many of the sharks and discard the carcasses so the actual shark catch may be larger than indicated.
Totals may not add due to in ability to estimate graphics precisely.
Note: Data entries estimated from graphic in source. The totals are similar to the southern results as most of the effort is concentrated on the southern grounds.
Source: Rogerio Menezes de Mello, Teodoro Vaske Jr., and Jorge P. Castello, "Pesqueria de atunes y pez espada por la flota arrendada de Rio Grande, Brazil," *Frente Marítimo*, Vol. 14, Sec. A, 1993, p. 131.

Appendix E3a1.--South Atlantic. Swordfish catch, 1980-97

Country/ Area	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997P
	Year																	
	Metric tons																	
Costal countries																		
Africa																		
Angola	-	-	-	-	26	228	815	84	84	84	-	-	-	-	-	-	-	-
Benin	-	-	24	-	86	90	39	13	19	26	28	28	26	28	-	1	-	-
Eq. Guinea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Ghana	110	5	55	5	15	25	13	123	235	235	235	235	235	-	-	-	140	-
Ivory Coast	-	-	-	-	10	10	10	10	12	7	10	21	15	19	24	24	-	-
Nigeria	-	-	-	83	69	-	-	-	-	-	-	-	3	-	857	-	-	-
South Africa	31	9	3	7	-	8	5	5	4	-	-	-	9	4	1	4	1	1
Togo	-	-	-	-	-	6	32	1	-	2	3	5	5	8	14	14	64	64
Subtotal	141	14	82	95	206	367	914	236	354	354	276	289	293	59	896	43	205	67
South America																		
Argentina	-	-	-	20	-	-	361	31	351	198	175	230	88	88	14	24	-	-
Brazil	1,125	405	613	471	341	342	449	436	692	927	1,017	721	629	674	969	1,172	777	2,040**
Uruguay	-	92	575	1,084	1,927	1,125	537	699	427	414	302	156	210	260	165	499	644	760
Subtotal	1,125	497	1,188	1,575	2,268	1,467	1,347	1,166	1,470	1,539	1,494	1,107	927	1,022	1,148	1,695	1,421	2,800
Total Coastal	1,266	511	1,270	1,670	2,474	1,834	2,261	1,402	1,824	1,893	1,770	1,396	1,220	1,081	2,044	1,738	1,626	2,867
Distant-water countries																		
Belize*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Brazil-leased###	410	222	391	283	122	227	304	511	470	241	679	591	1,980	1,339	602	572	1,142	2,192EI
Bulgaria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
China	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30
Cuba	316	147	432	818	1,161	1,301	95	173	159	830	448	209	246	192	452	778	60	60
Honduras*#	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	4	5
Lithuania	-	-	-	-	-	-	-	-	-	-	-	-	-	-	794	-	-	-
Japan	2,029	2,170	3,287	1,908	4,395	4,613	2,913	2,620	4,453	4,019	6,708	4,459	2,870	5,256	4,699	3,619	2,197	1,365
Korea	399	311	486	409	625	917	369	666	1,012	776	50	147	147	198	164	164	7	18
Panama*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	380	389	441
Russia/USSR	154	40	26	46	158	60	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	-	-	-	-	-	66	-	4,393	7,725	6,166	5,760	5,651	6,974	7,937	11,290	9,622	8,461
Taiwan	702	528	520	261	199	280	216	338	798	610	900	1,453	1,686	846	2,829	2,876	2,873	1,847
United States	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	171	396##
Subtotal	4,010	3,418	5,142	3,725	6,660	7,398	3,963	4,308	11,285	14,201	14,951	12,619	12,581	14,805	17,427	19,686	16,465	14,815
NEI-GFCM	-	-	-	-	-	-	-	-	-	856	439	-	-	-	-	-	-	-
Total^-Historical	5,276	3,929	6,412	5,395	9,134	9,232	6,224	5,710	13,109	16,950	17,160	14,015	13,801	15,886	19,471	21,424	18,091	17,682
-SCRS	5,323	3,975	6,447	5,402	9,139	9,586	5,894	6,030	12,956	16,927	17,215	13,878	13,801	15,812	19,556	21,423	18,097	17,544

EI - Instituto de Pesca estimates 2,340 t; preliminary FAO and ICCAT suggest slightly lower leased landings of 2,192 t (appendic E3b3a1).
NA - Not available
Negl - Negligible
NEI - Not elsewhere included
NR - Not reported

P - All the 1997 data should be considered as preliminary.
^ The historical data includes the Brazilian and leased data broken down from the annual ICCAT *Statistical Bulletin*. The SCRS is nor broken down, but includes
revisions of preliminary data not yet corrected in the *Statistical Bulletin*. The differences are not major. In most years they are similar, but never vary more than 200-300 tons.
* Flag of convenience fleets
** The SCRS reported a 1997 catch of 4,100 t, this is the combined total for domestic and leased fleets. The Instituto de Pesca (IP) in Santos reports a comparable catch of 4,380 t, 2,040 t for the domestic fleet and 2,340 for the leased fleet. Carlos Arfelli, Instituto de Pesca, personal communications, November 14, 1998.
# Observed off St. Helena
The United States reported discards of 21 t in 1997, the only discards report.
Some of the leased catch may appear in the totals for each country. The countries involved are: Barbados, Japan, Honduras, Korea, Portugal, Spain, or Taiwan. The detailed leased catch for each country through 1997 is reported in appendix E3b3a1.
Source: ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics*, (COM/97/17) Madrid, October 20-24, 1997, table SWO-Table 1. The authors have adjusted the SCRS table as explained in the footnotes.

Appendix E3a2.--Southwest Atlantic. Swordfish catch, 1980-96

Country/Area	Year																
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	Metric tons																
Southwest Atlantic (FAO area 41*)																	
Costal countries																	
Argentina	-	-	20	-	-	361	31	351	198	175	230	88	88	14	24	-	-
Brazil	1,582	655	1,019	781	468	569	762	956	1,162	1,168	1,696	1,312	2,609	2,013	1,571	1,744	1,926
Uruguay	-	92	575	1,084	1,927	1,125	537	699	427	414	302	156	210	260	165	499	636
Subtotal	1,582	747	1,614	1,865	2,395	2,055	1,330	2,006	1,787	1,757	2,228	1,556	2,907	2,287	1,760	2,243	2,562
Distant-water countries																	
Japan	136	256	119	46	46	342	574	593	772	718	1,253	941	907	587	657	174	178
Korea	19	11	35	5	77	134	51	56	6	24	-	-	-	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	153	-
Spain	-	-	-	-	-	-	-	-	-	849	2,619	2,898	2,948	4,545	5,186	7,339	3,671
Taiwan	259	195	178	93	53	81	59	169	268	272	543F	629	1,071F	541	1,354	1,357E	1,369
Subtotal	414	462	332	144	176	557	684	818	1,046	1,863	4,415	4,468	4,926F	5,673	7,197	9,023E	5,218
Total	1,996	1,206	1,946	2,009	2,571	2,612	2,014	2,824	2,833	3,620	6,643	6,024	7,833F	7,960	8,957	11,266	7,780

Negl - Negligible
* Southwestern Atlantic
Source: FAO. *Yearbook of Fishery Statistics*, various years.

Appendix E3a3.--South Atlantic. Swordfish catch, 1985-97

Year	South Atlantic		Total	Proportion
	Area 41*	Other		area 41
	Metric tons			Percent
1985	2.6	7.0	9.6	27
1986	2.0	3.9	5.9	34
1987	2.8	3.2	6.0	47
1988	2.8	10.2	13.0	22
1989	3.6	13.3	16.9	27
1990	6.6F	10.6	17.2	38
1991	6.0	7.9	13.9	43
1992	7.8F	6.0	13.8	57
1993	8.0	7.8	15.8	51
1994	9.0	10.6	19.6	46
1995	11.3	10.1	21.4	53
1996	7.8	10.3	18.1	43
1997	NA	NA	17.5	NA

* Southwestern Atlantic
Source: ICCAT, *Report of the Standing Committee on Research and Statistics* (Madrid, October 19-November 23, 1998), 11th Special Meeting of the Commission, Santiago de Compostela, Spain, November 16-23, 1998, COM/98/16 and ICCAT-SCRS, "Detailed report," October 17, 1998 (total south Atlantic data) and FAO *Yearbook of Fishery Statistics*, various years (Area 41 data).

Appendix E3a4.--South and north Atlantic. Swordfish catch, 1985-97

Year	Catch			Total
	N. Atl	Medit.	S. Atl	
	Metric tons			
1985	14.4	14.5	9.6	38.5
1986	18.5	16.0	5.9	40.4
1987	20.2#	17.5	6.0	43.7
1988	19.5	19.5#	13.0	52.0#
1989	17.3	16.8	16.9	51.0
1990	15.7	11.1	17.2	44.0
1991	14.9	10.7	13.9	39.5
1992	15.4	13.4	13.8	42.6
1993	16.8	13.3	15.8	45.9
1994	15.2	15.3	19.6	50.1
1995	16.6	12.9	21.4#	50.9
1996	14.8	12.1	18.1	45.0
1997	13.0	14.7	17.5	45.2

* Includes the Mediterranean
\# Record
Source: ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics*, (COM/97/17) Madrid, October 20-24, 1997, table SWO-Table 1; ICCAT, *Statistical Bulletin*, 1996; and ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics*, (COM/98/16) Madrid, October 19-November 23, 1998, table SWO-Table 1.

Appendix E3a5.--South Atlantic. Annual swordfish catches, 1970-97

Year	Catch*
	1,000 Metric tons
1970	5.4
1971	2.2**
1972	2.6
1973	3.1
1974	2.8
1975	3.1
1976	2.8
1977	2.9
1978	2.8
1979	3.3
1980	5.3**
1981	4.0
1982	6.5
1983	5.4#
1984	9.2**#
1985	9.6#
1986	5.9**#
1987	6.0
1988	13.0**+
1989	16.9+
1990	17.2
1991	13.9**
1992	13.8
1993	15.8
1994	19.6
1995	21.4+^
1996	18.1**+
1997	17.5P

P - Preliminary
* Most of the catch is taken by longlines. A small catch varying up to 943 t (1986) is taken by harpoons or other methods. This catch totaled only 140 t in 1996.
** These sharp changes were due to a major shift in Japanese fishing.
+ Spanish catches of over 4,000 t resulted when many vessels shifted from the north Atlantic to the south Atlantic, a process which continued into 1989 when they landed 7,700 t of swordfish. A massive increase in Spanish fishing was reported in 1995 when they caught 11,300 t of swordfish, but catches declined to 9,600 t in 1996.
# Foreign joint ventures in Uruguay added substantially to the catch beginning in 1982, especially during 1983-86.
^ All time record.
Source: ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics*, (COM/97/17) Madrid, October 20-24, 1997, table SWO-Table 1 and ICCAT-SCRS, *Report on the Standing Committee on Research and Statistics*, (COM/98/16) Madrid, October 19-November 23, 1998, table SWO-Table 1.

Appendix E3a6.--South Atlantic. Average annual catches, 1970-93/95

Country	Period		Change
	1970-93	1970-95	
	Percent		
Spain	21.9	25.1	+3.2
Taiwan	8.3	8.5	+0.2
Argentina	1.4	1.4	-
Uruguay	4.7	4.5	-0.2
Brazil	11.4	11.1	-0.3
Korea	6.8	6.4	-0.4
Others	4.6	4.1	-0.5
Cuba	5.4	4.4	-1.0
Japan	35.5	34.5	-1.0

Source: José Dias Neto and José Heriberto M. de Lima. "Technical considerations relevant for the allocation of catch quota for the south Atlantic swordfish stock," unpublished paper prepared in cooperation with a Brazilian working group under the framework of the SEGESP. The paper was prepared as a working document at a 1997 ICCAT meeting in João Pessoa.

Appendix E3a7.--South Atlantic. Dependence on south Atlantic swordfish grounds, 1970-93

Country	Atlantic catch		Total	Proportion South Atlantic
	North	South		
	Metric tons*			Percent
Brazil	-	799	799	100
Argentina	-	101	101	100
Uruguay	-	325	325	100
Taiwan	178	576	754	76
Korea	178	473	651	73
Japan	981	2,485	3,466	72
Cuba	278	374	652	57
Spain	5,391	1,531	6,922	22

* Average annual catches

Source: Source: José Dias Neto and José Heriberto M. de Lima, "Technical considerations relevant for the allocation of catch quota for the south Atlantic swordfish stock," unpublished paper prepared in cooperation with a Brazilian working group under the framework of the SEGESP. The paper was prepared as a working document at a 1997 ICCAT meeting in João Pessoa, table 4.

Appendix E3a8.--South Atlantic. Compliance with ICCAT south Atlantic swordfish catch quotas, 1995-97

Country	Membership status##	Limit*	1995 Catch	1995 Compliance**	1996 Catch	1996 Compliance**	1997 Catch	1997 Compliance**
		Metric tons		Percent	M. tons	Percent	M. tons	Percent
Argentina	NCP	250 (Min)	24	-90	NR	NA	NR	NA
Brazil	CP	2,013 (93)***	1,745	-13	1,922	-5	4,100	104
Cuba	CP	250 (Min)	778	+211	60	-76	60	-76
Honduras	NCP/FC	250 (Min)	6###	NCT	4###	NCT	5###	NCT
Japan	CP	5,256 (93)	3,619	-31	2,197	-58	1,365	-74
Korea	CP	250 (Min)	164	-34	7	-97	18	-93
Panama	NCP/FC	250 (Min)	-###	NCT	-###	NCT	-###	NCT
Portugal-EU	CP	250 (Min)	380	+52	389	+56	441	+76
Spain-EU	CP	7,937 (94)	11,290	+42	9,622	+21	8,461	+7
Taiwan	NCP	2,829 (94)	2,876	+ 2	2,873	+ 1	1,847	-35
United States	CP	250 (Min)	-	NA	171	-32	396	+58
Uruguay	CP	260 (93)***	499	+91	644	+148	760	+192

Note: African countries with small catches not included in this summary table.
EU - European Union member
FC - County making flag of convenience registrations
Min - The minimum limit was 250 t regardless of actual 1993-94 catches.
NA - Not available/Not applicable
NC - No calculation as the cap was zero.
NCT - Not calculated, total catch unknown
NR - Not reported
* The ICCAT quota or cap is the larger of the 1993 or 1994 catch.
** Percentage the actual catch was above or below the 1993-94 ICCAT cap.
*** Brazil, South Africa, and Uruguay deposited objections to the 1997 adopted recommendation that extended the 1996 catch agreement to the south Atlantic swordfish fishery. These countries noted their opposition to the use of trade measures, which they interpreted as potentially discriminatory against coastal developing states. They also expressed dissatisfaction with ICCAT's allocation process. The issue of allocations will be discussed at an ICCAT intercessional meeting to be held April 1999.
# A few African countries occasionally reported catches. The most significant was Ghana which reported a catch of 140 t in 1996.
ICCAT membership status:
CP - ICAAT contracting party (member)
NCP - ICCAT non-contracting party
Known to ICCAT, total catch believed to be larger
Source: ICCAT SCRS, *Report of the Standing Committee on Research and Statistics* (COM/97/17), Madrid 20-24, 1997, p. 84.

Appendix E3b1a.--Brazil. Swordfish catch and export comparisons in live-weight equivalents, 1970-98

Year	Catch							Comparative trade data**	
	FAO#	ICCAT		Total	SUDEPE/IBAMA/IP		Total		
		Brazil	Leased*		Brazil	Leased		U.S.	World***
			Metric tons						
1970			-						
1971			-						
1972	100		-						
1973	100		-						
1974	12		-						
1975	435		-						
1976	332	372	-	372					
1977	333	330	13	343					
1978	267	138	180	318					
1979	323	213	202	415	320	200	520		
1980	1,479	1,125	410	1,535	1,169	409	1,578		
1981	619	405	222	628	431	223	654		
1982	979	613	391	1,004	627	391	718	137	
1983	754	471	283	754	498	283	781	53	
1984	464	341	122	463	346	122	468	53	
1985	501	342	227	569	342	227	569	79	
1986	728	449	304	753	457	304	761	186	
1987	921	436	511	947	444	511	955	340	
1988+	1,159	692	470	1,162	693	470	1,163	663	
1989	989	927	241	1,168	926	241	1,167	604	
1990	1,696	1,017	679	1,696	1,024	679	1,103	833	NAEU
1991	1,312	721	591	1,312	721	590	1,311	867	1,210
1992	2,609	629	1,980P	2,609P	608	1,979	2,587	716	1,361
1993	2,013	674	1,339P*	2,013P	674	1,339	2,013	409	1,816
1994	1,571	969	602P	1,571P	969	602	1,571	481	520
1995	1,744	1,172	572P	1,744P	1,168	572	1,740	326	334
1996	1,926	777P1	1,149P1	1,926P1##	NA	NA	NA	804	824
1997	2,944P1	NA1	NA	4,100P1	2,040P1	2,340P1	4,380P1****	1,779	1,783
1998		NA2						2,000P2	2,150P2

FAO statistics appear to combine both the domestic and foreign leased fleet, presumably because the flag of the leased vessels are temporarily transferred to Brazilian registry.
The 1996 data is from various preliminary ICCAT SCRS reports. The authors note that available 1998 SCRS reports have made substantial changes to historical data as far back as the 1970s. The changes generally make closer to the FAO data. The authors, however, have only changed the data which appeared in the annual ICCAT *Statistical Bulletin*.
* Brazilian companies have leased vessels from foreign countries (appendices A1c and A2c3). The available 1997 leased data does not include information on several countries known to operate leased vessels (appendix E3b3a). While the final quantity may be slightly larger, it will probably not be much more than 100-200 t at most.
** Live weight equivalents of imports reported by major importers. The live weight equivalent was calculated as 70 percent of the product (actual) weight of export shipments.
*** The United States, Japan, and the European Union. The authors believe that these countries normally account for over 95 percent of all Brazilian swordfish shipments.
**** Dr. Carlos Arfelli, Instituto de Pesca, personal communications, November 14, 1998.
+ For several years there were differences between FAO and ICCAT annual statistical reports. ICCAT in 1996 revised its data, bring them into conformity with FAO data back to 1988. The ICCAT 1996 revisions were only reported in the *Statistical Bulletin* back to 1986. Other annual records may have also ben revise for previous years.
NA - Not available; NA1 - Trade data suggests a major catch increase; NA2 - Trade data suggests a minor catch increase.
NAEU - Import calculations unavailable before 1991 because EU data did not include Spanish data. Theoretically individual country data could be acquired, but this would involve an enormous effort and some country data, especially the Spanish data is difficult to work with.
P1 - Preliminary; P2 - Projection based on U.S. imports through October 1998
Acronyms: FAO - Food and Agriculture Organization of the United Nations; IBAMA - Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis (current Brazilian fisheries agency); ICCAT - International Commission for the Conservation of Atlantic Tunas; IP - Instituto de Pesca, Santos; SUDEPE - Superintendência do Desenvolvimento da Pesca (former Brazilian fisheries agency).
Sources: FAO, *Yearbook of Fishery Statistics*, various years (FAO data); ICCAT, *Statistical Bulletin*, various years and SCRS data for the most recent year (ICCAT data); and J. H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97, Part I, Vol. 2, (ICCAT: Madrid, 1997), p. 142 and previous national reports by Meneses (IBAMA data); ICCAT-SCRS. "Report on the Standing Committee on Research and Statistics," (COM/98/16) Madrid, October 19-23, 1998.

Appendix E3b1b.--Brazil. Swordfish catch as a proportion of the overall longline catch, 1976-97

Year	Domestic			Leased			Total#		
	Swordfish	Total	Proportion*	Swordfish	Total	Proportion*	Swordfish	Total	Proportion*
	Metric tons		Percent	Metric tons		Percent	Metric tons		Percent
1976	372	1,421	26	-	-	-	372	1,421	26
1977	330	1,424	23	13	470	3	343	1,894	18
1978	138	872	16	180	1,998	9	318	2,870	11
1979	213	1,361	16	202	1,509	13	415	2,870	14
1980	1,125	2,150	52	410	1,667	25	1,535	3,817	40
1981	405	1,140	36	223	1,902	12	628	3,042	21
1982	613	1,449	42	391	2,816	14	1,004	4,265	24
1983	471	1,458	32	283	2,263	12	754	3,721	20
1984	341	1,381	25	122	1,312	9	463	2,693	17
1985	342	896	38	227	1,160	20	569	2,056	39
1986**	449	1,320	34	304	2,281	13	753	3,601	21
1987	436	1,013	43	511	1,940	26	947	2,953	32
1988	692	1,487	47	470	2,247	21	1,162	3,734	31
1989	927	1,852	50	241	1,786	13	1,168	3,638	32
1990	1,017	2,030	50	679	1,775	38	1,696	3,805	44
1991	721	1,465	49	591	2,423	24	1,312	3,888	34
1992	629	1,262	50	1,980	6,984	28	2,609	8,246	32
1993	674	1,398	48	1,339	7,608	18	2,013	9,006	22
1994	969	1,372	71	602	2,969	20	1,571	4,341	36
1995	1,172P	1,587	74	572	4,562	13	1,744	6,149	28
1996	777P	1,164	67	1,149	4,442	26	1,926	5,606	34
1997	2,040I	NA	NA	2,192##	NA	NA	2,944	NA	NA

I - Instituto de Pesca data
NA - Not available
P - Preliminary
* Swordfish as a proportion of the total longline catch of swordfish and tunas.
** ICCAT revised its historical records in 1998, the data revised was published in the 1996 *Statistical Bulletin*, covering the period 1986-96. Data on revisions, if any, to previous years data is unavailable.
*** May not include the catch of all leased vessels.
# Computed in appendix E3b3a1.
The IP estimates 2,340 tons.
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), pp. 234-235 (1976-84 data) and ICCAT, *Statistical Bulletin*, 1996 (ICCAT: Madrid, Spain, 1996) (1985-96 longline data only); and Dr. carlos Arfelli, Instituto de Pesca, personal communications, November 14, 1998.

Appendix E3b1c.--Brazil. Swordfish catches of the domestic and leased fleet, 1976-97

Year	Swordfish catch			Proportion domestic**
	Domestic*	Leased#	Total	
	Metric tons			Percent
1976	372	-	372	100
1977	330	13	343	96
1978	138	180	318	43
1979	213	202	415	51
1980	1,125	410	1,535	73
1981	405	222	628	65
1982	613	391	1,004	61
1983	471	283	754	62
1984	341	122	463	74
1985	342	227	569	60
1986	449	304	753	60
1987	436	511	947	46
1988	692	470	1,162	60
1989	927	241	1,168	79
1990	1,017	679	1,696	60
1991	721	591	1,312	55
1992	629	1,980	2,609	32
1993	674	1,339*	2,013	33
1994	969	602P	1,571P	61
1995	1,172P	572P	1,744P	67
1996	777P	1,149P	1,926P	40
1997***	2,040P	2,340P##	4,380P	47

P - Preliminary
* Estimate of national scientists which may not agree with formal statistics or for which formal statistics are not available
** Domestic swordfish catch as a proportion of the total swordfish longline catch.
*** Data provided by Dr. Carlos Arfelli, Instituto de Pesca, personal communications, November 14, 1998. ICCAT indicates a 1997 catch of 4,100 t but has not yet reported the domestic/leased breakdown.
# See appendix E3b3a for individual country statistics.
The large increase is primarily due to expanded Spanish participation in the leasing program.
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), pp. 234-235 (1976-84 data) and ICCAT, *Statistical Bulletin*, various years (ICCAT: Madrid, Spain, 1996) (1985-96 data) and preliminary Instituto de Pesca statistics (1997 data).

Appendix E3b1d.--Brazil. Swordfish catch and effort data, 1994-95

Port/ fleet	Effort	Catch		Proportion swordfish	Swordfish CPUE*
		Swordfish	Total		
	Million hooks	Metric tons		Percent	Kg/1,000 hooks
Joao Pessoa					
Taiwan					
1990	-	-	-	-	-
1991	-	-	-	-	-
1992					
1993					
1994	2.3	166.0	1,587.0	10	72.1
1995					
Natal					
Brazil					
1990					
1991					
1992					
1993					
1994	0.3	19.4	245.4	8	64.7
1995					
Rio Grande (RS)					
Japan					
1990					
1991					
1992					
1993					
1994	1.1	108.8	913.4	12	98.9
1995					
Korea					
1990	-	-	-	-	
1991	-	-	-	-	
1992	-	-	-	-	
1993	-	-	-	-	
1994	0.6	19.1	371.4	5	31.8
1995					
Taiwan					
1990	-	-	-	-	
1991					
1992					
1993					
1994	1.0	51.2	340.1	15	51.2
1995					
Total, RS					
1990					
1991					
1992					
1993					
1994	2.7	179.1	1,642.9	11	66.3
1995					
Santos					
Brazilian					
1990		930.3	3,779.8	25	
1991		664.3	3,460.4	19	
1992		647.8	2,956.7	22	
1993		636.8	3,035.3	21	
1994	3.2	950.3	3,100.7	31	297.0
1995	2.1	1,019.0	2,544.2	40	485.2
Barbados					
1990	-	-	-	-	
1991	-	-	-	-	
1992	-	-	-	-	
1993	-	-	-	-	
1994	-	-	-		
1995	Negl	45.1	76.7	59	NA

Honduras					
1990					
1991					
1992	0.2	54.5	232.2	23	272.5
1993	0.3	53.1	299.2	18	177.0
1994	0.2	128.7	259.2	50	643.5
1995	0.1	101.3	154.7	65	1,013.0
Panama					
1990	-	-	-	-	
1991	-	-	-	-	
1992					
1993	Negl	23.4	53.6	44	585.0
1994	0.3	128.2	237.7	54	427.3
1995					
Total, Santos					
1990					
1991					
1992					
1993					
1994	3.7	1,207.2	3,597.6	34	326.3
1995	2.3	1,156.4	4,168.8	28	502.8

Source: Dr. Alberto Amorim, Instituto de Pesca, Santos, personal communications, April 20, 1996.

Appendix E3b2a1.--Brazil. Swordfish catch (domestic and leased vessels) by fishing area, 1958-97

Year	Atlantic area		Total
	North*	South	
	Metric tons		
1958	-	Negl	Negl
1959	-	Negl	Negl
1960	-	Negl	Negl
1961	-	440	440
1962	-	251	251
1963	-	125	125
1964	-	125	125
1965	-	125	125
1966	-	125	125
1967	-	62	62
1968	-	100	100
1969	-	181	181
1970	-	162	162
1971*	-	154	154
1972	-	121	121
1973	-	161	161
1974	-	465	465
1975	-	514	514
1976	-	365	365
1977	-	384	384
1978	-	367	367
1979	-	520	520
1980	-	1,579	1,579
1981	-	654	654
1982	-	1,018	1,018
1983	-	781	781
1984	-	467	467
1985	-	569	569
1986***	-	753	753
1987	-	947	947
1988	-	1,162	1,162
1989	-	1,168	1,168
1990	-	1,696	1,696
1991	-	1,312	1,312
1992	-	2,609	2,609
1993	-	2,013	2,013
1994	-	1,571	1,571
1995	-	1,744	1,744
1996	-	1,926P	1,926P
1997	-	2,944P	2,944P

* North of 5°N
** ICCAT published modified historical data in 1993. Statistics beginning with 1971 were changed.
*** ICCAT revised historical data in 1988, but the authors have details on those revisions only through 1986.
P - Preliminary
Source: ICCAT, "Report of the Standing Committee on Research and Statistics," *ICCAT Report*, Part I, 1988-89 (ICCAT: Madrid, Spain, 1989), p. 189 and ICCAT, "Report of the Standing Committee on Research and Statistics," *ICCAT Report*, Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), pp. 259-260 (1958-85 data) and ICCAT, *Statistical Bulletin*, 1996 (1986-96 data).

Appendix E3b2a2.--Brazil. Swordfish catch (domestic vessels) by fishing area, 1986-97

Year	Atlantic area		Total
	North*	South	
	Metric tons		
1986	-	449	449
1987	-	436	436
1988	-	692	692
1989	-	927	927
1990	-	1,017	1,017
1991	-	721	721
1992	-	629	629
1993	-	674	674
1994	-	969	969
1995	-	1,172	1,172
1996	-	777	777
1997	-	752	752

* Beginning at 5°N
Source: ICCAT, *Statistical Bulletin*, various years (1986-96 data) and preliminary data run (1997 data).

Appendix E3b2b.--Brazil. Swordfish longline catch (domestic and leased vessels) by fishing gear, 1958-97

Year	Gear		Total
	Longline	Other	
	Metric tons		
1958	NA	-	NA
1959	NA	-	NA
1960	NA	-	NA
1961	440	-	440
1962	251	-	251
1963	125	-	125
1964	125	-	125
1965	125	-	125
1966	125	-	125
1967	62	-	62
1968	100	-	100
1969	181	-	181
1970	162	-	162
1971	154	-	154
1972	121	-	121
1973	161	-	161
1974	465	-	465
1975	514	-	514
1976	365	Negl	365
1977	384	12	396
1978	367	5	372
1979	520	1	521
1980	1,579	3	1,582
1981	654	1	655
1982	1,018	1	1,018
1983	781	-	781
1984	467	1	468
1985	569	Negl	569
1986	761	1	762
1987	956	-	956
1988	1,159	-	1,159
1989	989	-	989
1990	1,499	-	1,499
1991	1,312	-	1,312
1992	2,609	-	2,609
1993	2,013	-	2,013
1994	1,571	-	1,571
1995	1,739	5	1,744
1996	1,926P	-	1,926P
1997	NA	NA	2,944P*

Note: Statistical discrepancies with appendix E3b1a are due to the use of older ICCAT reports using data that has since been revised. These older sources have been used as they specified gear.

* ICCAT and the Instituto de Pesca report preliminary estimates of 4,100-4,380 t respectively.

Source: ICCAT, "Report of the Standing Committee on Research and Statistics," *ICCAT Report*, Part I, 1988-89 (ICCAT: Madrid, Spain, 1989), p. 189 (1958-70 data); ICCAT, "Report of the Standing Committee on Research and Statistics," *ICCAT Report*, Part II, 1992-93 (ICCAT: Madrid, Spain, 1994), p. 260 (1971-90 data); ICCAT, *Statistical Bulletin*, various years (1991-96 data); and preliminary FAO data run (1997 data).

Appendix E3b2b2.--Brazil. Swordfish longline catch (domestic vessels) by fishing gear, 1985-97

Year	Gear*				Total
	Gillnet	LL	LLHB	LLMB	
		Metric tons			
1985	Negl	61N	274	-	335
1986	1L	83N	339	26N	449
1987		70N	341	25N	436
1988	-	34	633	25N	692
1989	-	192	698	37N	927
1990	-	37	930	50	1,017
1991	-	25	684	12N	721
1992	-	19	587	23	629
1993	-	-	637	37	674
1994	-	-	950	19	969
1995	5P	-	1,132P	35P	1,172P
1996	-	-	777P	-	777P
1997	NA	NA	NA	NA	2,040P

L - Formally reported by official sources, but ICCAT believes there are some irregularities associated with the data.
N - Estimated by researchers in the absence or conflicting with national statistics.
P - Preliminary
* Vessel-type abbreviations
LL - Longline
LLHB - Individually home-ported longliner
LLMB - Motherboat longliner
Source: ICCAT, *Statistical Bulletin*, various years.

Appendix E3b3a1.--Brazil. Swordfish catch of leased vessels, 1976-97

Year	Country									Total
	Barbados	Honduras	Japan	Korea	Panama*	Portugal	Spain	Taiwan	U.S.	
				Metric tons						
1976	-	-	-	-	-	-	-	-	-	-
1977	-	-	13	-	-	-	-	-	-	13
1978	-	-	180	-	-	-	-	-	-	180
1979	-	-	202	-	-	-	-	-	-	202
1980	-	-	410	-	-	-	-	-	-	410
1981	-	-	222	-	-	-	-	-	-	222
1982	-	-	391	-	-	-	-	-	-	391
1983	-	-	283	-	-	-	-	-	-	283
1984	-	-	122	-	-	-	-	-	-	122
1985	-	-	227	-	-	-	-	-	-	227
1986	-	-	304	-	-	-	-	-	-	304
1987	-	-	511	-	-	-	-	-	-	511
1988	-	-	470	-	-	-	-	-	-	470
1989	-	-	241	-	-	-	-	-	-	241
1990	-	-	679	-	-	-	-	-	-	679
1991	-	17N	122	-	-	-	-	452	-	591
1992	-	48	33	-	-	-	-	1,899	-	1,980
1993	-	77	85	-	-	-	-	1,177	-	1,339
1994	-	257P	109P	19P	-	-	-	217P	-	602P
1995	54	121P	53P	33P	-	-	-	311P	-	572P
1996	235P	148P	-	-	-	-	415	206P	138P	1,142P
1997	181P	226P	-	-	-	-	1,128	391P	266P	2,192P**

NA - Not available
P - Preliminary
* ICCAT doe not list any catch for the Panamanian vessels leased since 1993.
** The IP estimates 2,340 tons.
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report* Part II, 1984-85 (ICCAT: Madrid, Spain, 1986), pp. 234-235 (1976-84 data); and ICCAT, *Statistical Bulletin*, 1994 (ICCAT: Madrid, Spain) various years (1985-95 data); and Maurizo Perotti, FAO, personal communications, November 16, 1998 and ICCAT-SCRS, "1998 SCRS Report: SWO--Detailed report," October 17, 1998, table 1-2 (1996-97 data).

Appendix E3b3a2.--Brazil. Longline catch of leased vessels, 1986-96

Year	Country									Total
	Barbados	Honduras	Japan	Korea	Panama*	Portugal	Spain	Taiwan	U.S.	
	Metric tons									
1986	-	-	2,281	-	-	-	-	-	-	2,281
1987	-	-	1,940	-	-	-	-	-	-	1,940
1988	-	-	2,247	-	-	-	-	-	-	2,247
1989	-	-	1,786	-	-	-	-	-	-	1,786
1990	-	-	1,775	-	-	-	-	-	-	1,775
1991	-	31	824	-	-	-	-	1,568	-	2,423
1992	-	87	306	-	-	-	-	6,571	-	6,984
1993	-	113	904	-	-	-	-	6,591	-	7,608
1994	-	306	688	340	-	-	-	1,635	-	2,969
1995	66	145	415	373	-	-	-	3,563	-	4,562
1996	274	196	NA	-	-	-	466	3,356	150	4,442
1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

* ICCAT does not list any catch for the Panamnian vessels leased since 1993.
Source: ICCAT, *Statistical Bulletin*, 1996 (ICCAT: Madrid, Spain) various years (1986-96 data).

Appendix E3b3b.--Brazil. Swordfish proportion of the Japanese (leased) longline catch, 1977-89

Year	Swordfish* proportion
	Percent
1977	2**
1978	8
1979	12
1980	25
1981	12
1982	13
1983	12
1984	10
1985	16
1986	12
1987	22
1988	18
1989	13

* Proportion of swordfish in the retained catch of the leased Japanese longline fleet.
** Low catch rate may be due to extensive operations on northern grounds during the initial years of the fishery.
Note: Data entries estimated from graphic in source.
Source: Rogerio Menezes de Mello, Teodoro Vaske Jr., and Jorge P. Castello, "Pesqueria de atunes y pez espada por la flota arrendada de Rio Grande, Brazil," *Frente Marítimo*, Vol. 14, Sec. A, 1993, p. 131.

Appendix E4a.--Brazil. Tuna catch, 1980-96

Year	Species			
	Albacore	Bigeye	Yellowfin	Skipjack
		Metric tons		
1980	181	677	1,007	6,334
1981	87	513	2,182	13,913
1982	100	730	2,078	18,322
1983	36	525	2,799	15,945
1984	207	658	2,141	13,568
1985	380	415	2,882	25,068
1986	498	835	1,534	15,278
1987	319	700	1,820	10,678
1988	423	945	2,309	17,316
1989	443	506	2,482	20,750
1990	514	583	1,701	20,130
1991	1,113	350	1,838	20,548
1992	2,710	750	4,228	18,535
1993	3,613	1,256	5,131	17,771
1994	1,227	596	4,169	20,588
1995	923	1,935	4,022	16,560
1996	858	1,647	2,011	17,667

Source: FAO, *Yearbook of Fishery Statistics*, various years.

Appendix E4b1.--Brazil. Billfish catch other than swordfish, 1988-95

Fleet Species	Year							
	1988	1989	1990	1991	1992*	1993*	1994*	1995
				Metric tons				
Brazilian								
Sailfish	110	123	92	57	32	46	40	32
Marlin								
White	114	173	161	281	117	78	72	60
Blue	20	30	19	17	17	16	18	43
Subtotal#	243	325	272	354	166	140	131	135
Leased*								
Sailfish	6	1	2	9	251	177	25	65
Marlin								
White	35	32	41	96	91	350	18	43
Blue	44	29	31	43	109	139	57	126
Subtotal#	85	62	74	148	451	666	100	234
Combined fleets								
Sailfish	116	124	94	66	283	223	65	97
Marlin								
White	149	205	202	377	208	428	90	103
Blue	64	59	50	60	126	155	75	169
Grand total#	329	388	346	503	617	806	230	369

Note: Meneses de Lima in 1997 suggested substantial changes in the domestic catch data.
* Preliminary data
# Totals may not agree due to rounding
Source: J.H. Meneses de Lima, "National report of Brazil," for 1995 ICCAT meeting and Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (Vol. I, Part II), (ICCAT: Madrid, 1997), p. 142.

Appendix E4b2a.--Brazil. Billfish catches, 1970-79

Species/ fishery	Year									
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
	Metric tons									
Marlin										
Blue										
LLHB	38	21	26	8	16	12	22	-	12	14
SURF	NA	NA	NA	NA	NA	NA	11	52	2	15
SPOR	1	-	-	-	-	-	-	-	-	-
JALL	NA	NA	NA	NA	NA	NA	-	136	29	4
KOLL	NA	NA	NA	NA	NA	NA	12	35	-	-
TALL	NA	NA	NA	NA	NA	NA	240	107	177	139
White										
LLHB	54	15	94	10	36	31	31	12	20	17
SURF	NA	NA	NA	NA	NA	NA	25	3	2	4
SPOR	1	-	-	-	-	-	-	-	-	-
JALL	NA	NA	NA	NA	NA	NA	-	91	143	111
KOLL	NA	NA	NA	NA	NA	NA	10	23	-	-
TALL	NA	NA	NA	NA	NA	NA	377	119	197	155
Sailfish										
LLHB	21	70	105	37	82	88	114	96	98	42
SURF	NA	NA	NA	NA	NA	NA	62	119	90	84
SPOR	NA	NA	NA	NA	NA	NA	-	-	-	-
JALL	NA	NA	NA	NA	NA	NA	-	-	41	26
KOLL	NA	NA	NA	NA	NA	NA	10	41	-	-
Total	115	106	225	55	134	131	914	834	811	611

Source: ICCAT, *ICCAT Report*, 1987, Part II, SCRS/87/13/Amended (ICCAT: Madrid, Spain, 1988), pp. 184-186.

Appendix E4b2b--Brazil. Billfish catches, 1980-86

Species	Year						
	1980	1981	1982	1983	1984	1985	1986
	Metric tons						
Marlin							
Blue							
LLHB	12	-	1	1	11	-	-
SURF	7	20	20	3	1	-	-
SPOR	-	-	-	-	1	1	1
JALL	8	3	15	15	20	2	25
KOLL	-	-	-	-	-	-	-
White							
LLHB	32	31	23	41	52	4	-
SURF	3	Negl	Negl	Negl	Negl	-	-
SPOR	-	-	-	-	Negl	Negl	Negl
JALL	26	5	59	25	8	36	36
KOLL	-	-	-	-	-	-	-
Sailfish							
LLHB	81	46	61	42	86	34	-
SURF	87	55	53	8	4	-	-
SPOR	-	-	-	-	37	26	35
JALL	12	Negl	7	7	1	2	2
KOLL	-	-	-	-	-	-	-
Total	268	160	239	142	221	105	99

Note: More recent ICCAT publications show higher billfish catches (appendices E4b3b and E4b4).
Source: ICCAT, *ICCAT Report*, 1987, Part II, SCRS/87/13/Amended (ICCAT: Madrid, Spain, 1988), pp. 184-186.

Appendix E4b2c--Brazil. Billfish catches, 1986-89

Species	Year			
	1986	1987	1988	1989
	Metric tons			
Marlin				
Blue				
LL	-	1N	-	-
LLMB	7N	6N	6N	4
LLHB	6N	6N	13N	26N
SURF*	1N	12N	10	-
SPOR	1	Negl	1N	1G
HAND	-	-	-	-
GILL	3N	-	-	-
White				
LL	1N	1N	-	-
LLMB	6N	6N	6N	16N
LLHB	97N	52N	107N	157
SURF*	Negl-N	3N	1	-
SPOR	Negl	-	-	Negl-N
GILL	-	-	-	-
Sailfish				
LL	-	-	-	-
LLMB	5N	4N	4N	11
LLHB	225N	125N	105	112N
SURF*	1N	5N	10	-
SPOR	35	36	27	23N
GILL	24N	-	-	-
Total	412	257	290	350

G - Estimated by the ICCAT Secretariat based on the best available data.
N - Estimate by Brazilian scientist as national statistics were not available.
* Trolling and gillnetting
Source: ICCAT, *Statistical Bulletin*, 1996.

Appendix E4b2d--Brazil. Billfish catches, 1990-96

Species	Year						
	1990	1991	1992	1993	1994	1995	1996
	Metric tons						
Marlin							
Blue							
LL	-	-	-	-	-	-	-
LLMB	6	2	2	2P	3	3P	-
LLHB	13N	15N	14	17	18P	40P	59P
SURF	-	-	-	-	-	9P	2E
SPOR	2N	1N	Negl-P	1P	2P	2E	2E
HAND	-	-	-	-	-	-	Negl-P
GILL	-	-	-	-	-	-	21P
White							
LL	2	4	3	-	-	-	-
LLMB	11	7	5	6P	-	2P	-
LLHB	147	270N	111	71P	72P	57P	46P
SURF	-	-	-	-	-	-	-
SPOR	4N	Negl-N	Negl-P	Negl-P	Negl-P	4P	4E
GILL	-	-	-	-	-	-	1P
Sailfish							
LL	4N	-	-	-	-	-	-
LLMB	4	4N	3	2P	1	3P	-
LLHB	88N	53N	30	49	33	29P	29P
SURF	184	-	33	21	41	143P	224P
SPOR	19N	25N	33P	21P	28P	5P	-
GILL	-	-	-	-	-	-	-
Total	484	381	234	190	198	297	396

E - Estimates by the SCRS or SCRS Working Group. Includes estimates by national scientists, or by the Secretariat, which have been reviewed and approved by the SCRS.
G - Estimated by the ICCAT Secretariat based on the best available data.
N - Estimate by Brazilian scientist as national statistics were not available.
P - Preliminary nominal catch reported by national office, either by formal publication or by formal correspondence.
* Trolling and gillnetting
Source: ICCAT, *Statistical Bulletin*, 1996.

Appendix E4b3.--Brazil. Overall billfish catch (excluding swordfish), 1986-96

Year	Country*									Total	Proportion domestic
	Domestic	Barbados	Spain	Honduras	Japan	Korea	Portugal	Taiwan	U.S.		
	Metric tons										Percent
1986	412	-	-	-	69	-	-	-	-	481	86
1987	257	-	-	-	61	-	-	-	-	318	81
1988	290	-	-	-	85	-	-	-	-	375	77
1989	350	-	-	-	61	-	-	-	-	411	85
1990	484	-	-	-	74	-	-	-	-	558	87
1991	381	-	-	1N	40	-	-	106X	-	528	72
1992	234	-	-	15	10	-	-	428P	-	687	34**
1993	190	-	-	14	21X	-	-	466P	-	691	27**
1994	198	-	-	14P	17P	10P	-	61P	-	292	68
1995	297	2P	-	10P	25P	4	-	192P	-	530	56
1996	396	14P	5P	11P	NA	NA	-	282P	8P	(716#)	55

N - Estimate by Brazilian scientist as national statistics not available
P - Preliminary
X - More than one source
* The catch data refers to the catch of these countries in association with Brazilian companies, not the county's overall catch.
** The decline in the domestic share was due to the entry of large numbers of Taiwan longliners into the leasing program.
Source: ICCAT, *Statistical Bulletin*, 1996 (ICCAT: Madrid, Spain, 1998).

Appendix E4b4.--Brazil. Overall billfish catch (excluding swordfish) of the domestic fleet, 1986-96

Year	Fleet*				Total	Proportion longline
	Gillnet	Longline**	Sport	Surface***		
	Metric tons					Percent
1986	27N	347	36	2N	412	84
1987	-	201N	36	20N	257N	78
1988	-	241X	28X	21	290X	83
1989	-	326XN	24X	-	350XN	93
1990	-	275X	25N	184	484XN	57
1991	-	355XN	26N	-	381XN	92
1992	-	168	33P	33	234	72
1993	-	147XP	22P	21	190XP	77
1994	-	127X	30P	41	198XP	64
1995	-	134P	11X	152P	297P	45
1996	32P	134P	6E	224P	396P	34

E - Standing Committee on Research Statistics (SCRS) or SCRS Working Group estimate.
N - Estimate by Brazilian scientist as national statistics not available
P - Preliminary
X - More than one source
* The principal Brazilian domestic fleets reporting billfish catches
** ICCAT reports different domestic longline fleets, however, the difference in these fleets is not readily apparent and calls to ICCAT did not help to clearly differentiate the fleets.
*** Trolling and gillnetting, primarily by artisanal fishermen
Source: ICCAT, *Statistical Bulletin*, 1996 (ICCAT: Madrid, Spain, 1998).

Appendix E4b5.--Brazil. Billfish catch (excluding swordfish) composition of the domestic fleet, 1986-96

Year	Species			Total	Proportion sailfish
	Sail	BMar	WMar		
	Metric tons				Percent
1986	290N	18N	104N	412N	70
1987	170N	25N	62N	257N	66
1988	146	30N	114N	290N	50
1989	146N	31NG	173	350N	42
1990	299N	21N	164	484N	62
1991	82N	18N	281N	381N	22
1992	99P	16	119	234P	42
1993	93P	20	77P	190P	49
1994	103P	23P	72P	198P	52
1995	180P	54P	63P	297P	61
1996	263P	82P	51P	396P	66

G - ICCAT estimate
N - Estimate by Brazilian scientist as national statistics not available
P - Preliminary
X - More than one source
Source: ICCAT, *Statistical Bulletin*, 1996 (ICCAT: Madrid, Spain, 1998).

Appendix E4c1.--Brazil. Shark catch of the Brazilian and leased fleet and catch composition, 1988-95

Year	Brazil		Leased	
	Quantity	Proportion	Quantity	Proportion
	Metric tons	Percent	Metric tons	Percent
1988	1,298	45	481	18
1989	1,962	50	211	11
1990	2,706	55	391	18
1991	2,517	60	404	14
1992	2,000	60	575	8
1993	2,137	61	1,439	12
1994	1,892	54	720	19
1995	1,461	44	692	13

Source: Meneses de Lima, "National report of Brazil," *ICCAT Report*, 1996-97 (Vol. I, Part II), (ICCAT: Madrid, 1997), p. 143.

Appendix E4c2.--Brazil. Catch (dressed weight) of pelagic sharks and proportion of longline catch, 1977-90

Year	Brazilian fleet						Leased fleet#		Total
	Santos		R.G do Sul##		Northeast				
	Quantity	Proportion	Quantity	Proportion	Quantity	Proportion	Quantity	Proportion	Quantity
	Metric tons*	Percent	Metric tons*	Percent	Metric tons*	Percent	Metric tons*	Percent	Metric tons*
1977	234.8	16.4					92.7	18.6	327.5
1978	323.6	21.3					226.7	12.6	550.3
1979	405.5	20.8					228.7	14.4	634.2
1980	450.1	18.9					329.1	19.7	779.2
1981	606.4	34.4					410.8	21.6	1,017.2
1982	521.8	26.9	22.3	18.3			761.4	27.0	1,305.5
1983	680.0	37.2	207.0	48.2	5.5	29.3	674.6	28.6	1,567.2
1984	796.2	43.5	169.4	53.6	38.4	31.7	222.2	16.9	1,218.2
1985	653.4	47.3	125.9	59.5	57.0	32.1	328.4	22.1	1,164.7
1986	650.4	38.2	169.5	55.6	120.2	30.7	386.8	14.5	1,326.9
1987	603.5	42.2	115.5	52.3	187.1	53.2	485.1	20.0	1,391.2
1988	665.4	34.6			160.7	40.7	484.2	17.7	1,310.3
1989	888.7	44.3			153.1	32.9	216.2	10.8	1,258.0
1990	1,317.4	50.3			151.0	24.0	391.4	18.1	1,559.8

* Dressed weight
# Data available only for Japanese vessels.
Rio Grande do Sul
Source: J.H. Meneses de Lima, "National report of Brazil," *ICCAT Report*, Part I, 1992 (ICCAT: Madrid, Spain, 1993), p. 339.

Appendix E4c3.--Brazil. Swordfish and shark longline catches, 1977-94

Year	Swordfish		Shark	
	South*	Northeast**	South*	Northeast**
		Metric tons		
1977	322.8		234.8	
1978	212.6		323.6	
1979	319.9		405.5	
1980	1,169.4		450.1	
1981	413.0		606.4	
1982	626.8		544.1	
1983	496.7	0.8	887.0	5.6
1984	341.1	4.4	965.6	30.4
1985	342.0	Negl	779.3	57.0
1986	430.5	26.3	819.9	120.2
1987	419.3	24.9	719.0	187.1
1988	667.5	25.0	1,073.4	225.0
1989	889.5	36.7	1,748.1	214.3
1990	967.2	50.3	2,394.9	211.4
1991	748.4	11.8	2,361.4	156.5
1992	589.1	21.2	1,683.0	339.8
1993	582.1	36.7	1,720.7	416.4
1994	990.0	19.4	1,719.6	182.1

* Including the Southeast landed in Santos and Rio Grande
** landed in Recife and Natal
Source: Melquíades Pinto Paiva, *Recursos Pesqueiros Estuarinos E Marinhos Do Brasil* (Fortaleza: UFC Edições, 1997), pp. 222-225.

Appendix E5a1.--Caribbean. Turtle interaction comparisons

Year	Areas*					
	Caribbean	ECFlorida	NCAtlantic	EqAtlantic	FEqAtlantic	Hawaii**
	Turtle hookings per 1,000 hooks deployed					
1992	0.68	-	NO	NO	NO	NA
1993	0.23	0.13	0.13	NO	NO	NA
1994	0.13	0.09	0.08	NO	NO	0.06***
1995	-	0.49	0.15	NO	NO	0.05
1996	0.45	-	0.10	0.05	NO	0.06
1997	0.27	0.11	0.15	0.34	0.13	0.07

NA - Not available
NO - No observations
Note: For level of activity and absolute number of interactions see, Venezuela, appendix D7d2.
The observers report that many of the hooked turtles are released alive, but data on survival rates are unavailable.
* Areas: Are based on the standard areas adopted by the observer program. See attached map.
ECFlorida - Florida East Coast
NCAtlantic - Northcentral Atlantic
EqAtlantic - Equatorial Atlantic (Tuna 1)
FEqAtlantic - Far Equatorial Atlantic (Tuna 2)
** The turtle bycatch rates indicated here come from a through assessment of the Hawaiian longline fishery and should bed given greater credence than the raw observer data available for the Atlantic areas mentioned. NMFS has contracted an assessment of turtle interactions along the Atlantic and that data should be available by May 1998.
*** February 24, 1994 - February 23, 1995. Subsequently restated to 0.05.
Sources: Dennis Lee, computer run of Atlantic observer data, March 3, 1998 (Atlantic data) and Hilda Diaz-Soltero, "Annual Report on Implementation of a Biological Opinion," NMFS memos, various years (Hawaiian data).

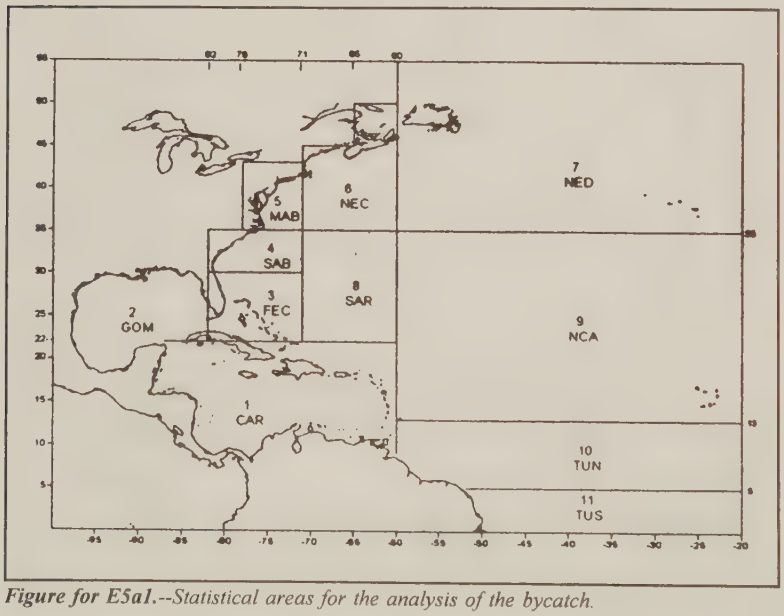

Figure for E5a1.--Statistical areas for the analysis of the bycatch.

Appendix E5a2.--Brazil. Pelagic longline interactions with sea turtles off southern Brazil, 1998

Set	Turtles#				Effort	CPUE	Temperature		Location		Area	Zone	Water depth
	Live	Dead	NR	Total			Sea*	Air	Lat	Long			
		Number			Hooks	Tur/1,000h	C°		S°	W°			Meters
1	23	4	-	27	1,100	24.6	20	24	30 00′	37 00′	1	Int	638/3,050
2	7	5	-	12	1,000	12.0	16	24	29 57′	36 41′	1	Int	638/3,050
3	5	1	-	6	1,000	6.0	15	23	29 50′	36 19′	1	Int	638/3,050
4	11	2	4	17	1,100	15.5	11	22	31 14′	40 01′	2	Int	3,936
5	12	-	6	18	1,000	18.0	13	23	31 24′	40 04′	2	Int	3,936
6	11	-	-	11	1,000	10.0	16	22	31 25′	40 01′	2	Int	3,936
7	10	1	-	11	1,000	11.0	11	23	30 52′	44 51′	3	Int	3,419
8	4	1	-	5	1,000	5.0	12	23	33 42′	50 37′	4	EEZ	3,402
9	-	1	-	1	1,000	1.0	10	22	32 15′	47 45′	4	EEZ	170
Total	83	15	10	108	9,300								
Average						11.6	14	23					

Note: This data was collected during March 13 and April 12 aboard the domestic Brazilian longliner *Yamaya III*.
CPUE - Catch per unit effort
EEZ - Catch taken within Brazil's 200-mile Exclusive Economic Zone
h -hooks
Int - International waters
Lat - Latitude
Long - Longitude
NR - Not recorded
All loggerheads and believed to be juveniles. The curved carapace lengths varied from 46-70 cm and the mean was 60 cm, based on 9 samples.
* Sea surface temperatures
Source: C.P.R. Barata, B.M.G. Gallo, S. dos Santos, V.G. Azevedo, and J.E. Kotas, "Captura incidental da tartaruga marinha *Caretta caretta* (Linneaus, 1758) na pesca de espinhel de superficie na ZEE brasilieira e em águas internacionais," *XI Semana Nacional de Oceanografia. Oceanografia e Suas Interfaces Resumos Expandidos* (Fundação Universidade do Rio Grande: Centro Acadêmico Livre de Oceanologia: Rio Grande, 1998) and Paulo Barata, TAMAR, personal communications, January 28, 1999.

Appendix E5b1.--Brazil. Number of birds caught by the Santos longline fleet, 1994-95

Year/ month	Bird Bycatch
	Number
1994	
November	-
December	3
1995	
January	-
February	-
March	2
April	-
May	7
June	13
July	35
August	41
September	15
October	2

Source: Tatiana Neves and Fabio Olmos, "Albatross mortality in fisheries off the coast of Brazil," in G. Robertson and R. Gales, (ed.) *Albatross Biology and Conservation* (Chipping Norton: Surrey Beatty & Sons, 1997), pp. 214-219.

Appendix E5b2.--Brazil. Daily timing of longline sets and seabird interactions reported by the Santos fleet, 1994-95

Time	Results	
	Sets	Birds
	Percent*	
3-4PM	1	-
4-5PM	3	7
5-6PM	12	21
6-7PM	28	38
7-8PM	25	24
8-9PM	15	6
9-10PM	8	3
10-11PM	3	1
11-12PM	3	-
12-1PM	Negl	-
1-2PM	Negl	-

Note: Values entered visually from a graphic.
* Percentage of sets and bird interactions during each time period
Source: Tatiana Neves and Fabio Olmos, "Albatross mortality in fisheries off the coast of Brazil," Chapter 17 in G. Roberstson and R. Gales, ed. *The Albatross Biology and Conservation* (Surrey Beatty & Sons: Clipping Norton, 1997).

Appendix E5b3.--Brazil and Uruguay. Known catch rates of seabirds in longline fisheries, 1990-94

Region	Fishery	Year	Estimated hooks	Observed bird catch Number	Observed bird catch Rate	Implied mortality	Reference
			1,000 hooks	Number	Birds/1,000 hooks		
Brazil	Tuna*	1990	18.6	71	3.82	2,650	WG-IMALF-94/5
Brazil/Uruguay	Tuna*	1994	55.6	280	5.03	NA	WG-IMALF-94/17

Note: The observed bird catch rate is much higher than reported by the source in other fisheries.
* The tuna longline fishery off Brazil and Uruguay is a multiple species fishery also taking swordfish, billfish and shark.
Source: Karen Alexander, Graham Robertson, and Rosemary Gales, *The Incidental Mortality of Albatrosses in Longline Fisheries*, Report on the Workshop from the First International Conference on the Biology and Conservation of Albatrosses, Hobart, Tasmania, Australia, September 1995, (Australia, March 1997), p. 23.

Appendix E6.--Latin America. Implementation of ICCAT swordfish management recommendations

Country	Regulation number	Date
Brazil	Portaria 115	August 17, 1998
Cuba*	NA	NA
Uruguay	Decreto 306/995	August 9, 1995
Venezuela	NA**	NA

NA - Not available
* Withdrew from ICCAT December 31, 1991
** The authors know of no Venezuelan minimum size regulations.
Source: Various country sources.

Appendix F1.--Brazil. Processing of longline catch

Product/species	Price
	Reales*
Fillets	
Dorado	NA
Shark (machote)	8.50
Swordfish	9.00
Postas??	
Albacore	8.00
Dorado	4.00
Marlin	
Blue	NA
White	4.50
Shark (caçao)	5.50
Swordfish	9.00
Cubes	
Shark (caçao)	6.00
Swordfish	NA
Steaks (lomos)	
Albacore	8.00
Sailfish	5.50
Swordfish	NA

* Roughly equivalent to US$1.00.
Source: Imaipesca price list, April 19, 1996.

Appendix F2a.--Brazil. Companies handling swordfish, exempted from automatic FDA detention, May 1998

Company	Exemption issued	
Bamar do Brazil		
Com. e Ind. de Pescados Kowalski	09/30/96	
Comercial de Pescados Villa	08/20/96	
Estaleiro Naval San Pedro	11/03/97	16A42
Exportadora Pargo	02/04/92	
Imaipesca Industria e Comercia de Pescado	05/23/97	16A42
Mares do Sul	NA	
N. Pesca	04/15/97	16A42
New Symbol Comercio Exportador	05/05/95	
Norte Pesca	07/03/97	
Ocean Pacific Seafood	05/29/96	
Olinda Captura, Industria e Comercio	03/19/97	
Sulpesca Exportação	NA	
Taiyo Industrias de Pescas	02/11/97	

NA - Date of exemption not available, but these are the older exemptions before FDA began noting the date on their internet site.
Note: These companies will theoretically have the best quality fresh product as other companies will have to have their shipments tested upon arrival in the United States. The testing process usually takes at least 2 days.
Updates: Updates of this list are available at the following FDA internet address.
Source: FDA, "Detention without physical examination of swordfish for methyl mercury," IA#16-08, attachment listing shippers/manufacturers exempt from automatic detention, internet posting (http://www.fda.gov/ora/fiars/ora_import_ia1608.html), revised May 7, 1998.

Appendix F2b.--Brazil. Companies shipping swordfish to the United States without automatic detention exemption, 1997

Company(location)/ date	Product	Entry	Detention type
Alvarenga Com. e Ind. de Pesca (Espirito Santo)			
08/26/97	Fresh swordfish	New York	A
Estaleiro Naval San Pedro (Santa Catarina/Balneario Camboriu)			
03/17/97	Swordfish	Florida	A
04/10/97	Fresh swordfish	NWE	A
05/05/97	Fresh swordfish	NWE	A
05/29/97	Fresh whole swordfish	New York	A
08/11/97	Fresh swordfish	NWE	A
08/11/97	Fresh whole swordfish	NWE	A
09/08/97	Fresh swordfish	NWE	A
09/24/97	Fresh swordfish	NWE	A
10/08/97	Fresh whole swordfish	NWE	A
Imaipesca (Santos)			
03/21/97	Swordfish	Florida	A
04/21/97	Swordfish	Florida	A
05/01/97	Fresh swordfish	New York	A
05/01/97	Fresh swordfish	New York	A
05/05/97	Swordfish	Florida	A
05/05/97	Swordfish	Florida	A
05/12/97	Swordfish H&G	Florida	A
05/12/97	Swordfish H&G	Florida	A
05/28/97	Fresh swordfish	Florida	A
Jen-Mar Importçao & Exportaço (Sao Paulo)			
05/12/97	Swordfish	Florida	A
Norte Pesca (Recife)			
03/03/97	Swordfish	Florida	A
04/09/97	Swordfish H&G	Florida	A
Norte Pesca (Natal)			
11/06/96	Fresh H&G swordfish	Florida	D-Mercury
02/21/97	Fresh swordfish	Florida	A
03/14/97	Fresh swordfish	Florida	A
06/26/97	Fresh swordfish	Florida	A
Norte Pesca (Rio Grande do Norte)			
03/06/97	Fresh swordfish	New York	A
Norte Pesca (Unknown)			
07/09/97	Swordfish	Florida	A
Taiyo Industria de Pesca (Santos)			
01/27/97	Fresh swordfish	Florida	A
01/28/97	Fresh swordfish	Florida	A
02/19/97	Fresh swordfish	New York	A
02/19/97	Fresh swordfish	New York	A
02/19/97	Fresh swordfish	New York	A

A - Automatic alert
D - Regular detention
Source: FDA, "Monthly detentions," internet posting (http://www.fda.gov/ora/ids), updated monthly by FDA.

Series G Appendices: Trade
G1: Overall
G2: United States
G3: Japan
G4: European Union

Appendix G1a.--Brazil. Swordfish exports by destination, 1991-98

Destination	Years								
	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Metric tons								
United States	583	607	501	286	337	228	563	1,245	1,400P
Japan*	-	1	64	74	-	-	-	3	NA
European Union	NA	239	388	911	28	6	14	120	58#
Taiwan**	-	-	-	-	-	-	-	-	NA
Others***	NA	NA	NA	NA	NA	NA	NA	3	NA
Total	NA	847	953	1,271	365	234	577	1,248	1,500P

NA - Not available
P - NMFS projection based on U.S. shipments through October 1998 (appendix G2g).
* Estimated swordfish portion of billfish shipments (appendix G3a).
** A substantial fleet of Taiwan longliners operated out of Brazilian ports during 1991-94 (appendix A1c). Their catch was landed in Brazilian ports and reported to FAO as Brazilian catch. The export shipments appear to have been identified as Brazilian. The authors, however, have been unable to obtain detailed Taiwan import data. Taiwan has a basket category marked "marlin" which probably means all billfish and swordfish. Imports in 1996, for example, totaled 107 t, but there was no indication of the country of origin or how much of the total was swordfish. The category was a new entry in their annual statistical yearbook and thus there is no historical data. Taiwan Fisheries Bureau, *Fisheries Yearbook Taiwan Area* (Taiwan Fisheries Bureau: Taipei, June, 1997), p. 185. Taiwan officials report that most of Taiwan imports come from Australia. Shipments from Brazil are believed to be nil or negligible.
*** Swordfish shipments to other countries are believed to be non-existent or negligible
# Through July
Source: Various

Appendix G1b1.--Brazil. Estimated domestic consumption of swordfish, 1991-98

Year	Catch*		Exports**	Difference***		Proportion	
	Total	Domestic		Total	Domestic	Total	Domestic
			Metric tons			Percent	
1991	1,312	721	1,210	102	-489	8	NS
1992	2,609	629	1,361	1,248	-619	48	NS
1993	2,013	674	1,816	197	-1,142	90	NS
1994	1,571	969	521	1,050	448	67	46
1995	1,744	1,172	334	1,410	838	81	72
1996	1,926	777	824	1,102	-47	57	NS
1997	4,100	2,040	1,783	2,317	257	57	13
1998			2,150				

* Includes both domestic and leased vessels (appendix E3b1a)
** Live weight equivalent of product weight data (appendix G1a). Product weight was converted to liveweight with a conversion factor of 0.7 to 1.0.
*** The difference is presumably domestic consumption, but the sharp annual fluctuations suggest either statistical problems with the data or other unknown factors are involved with the marketing of Brazilian swordfish.
A - Apparent
Sources: ICCAT, *Statistical Bulletin*, 1996 (1991-96 catch data) SCRS reports and Instituto de Pesca (1997 catch data) and trade data of major importing countries summarized in appendix G1a (export data).

Appendix G1b2--Brazil. Estimated domestic consumption of swordfish, 1991-98

Year	Catch*	Exports**	Difference***	Domestic proportion
		Metric tons		Percent
1991	721	1,210	-489A	NS
1992	629	1,361	-732A	NS
1993	674	1,816	-1,142A	NS
1994	969	521	448A	46
1995	1,172	334	838A	72
1996	777P1	824	-47A	NS
1997	2,040P2	1,783	257A	13
1998	NA	2,150P3	NA	NA

Note: The authors speculated that differing marketing channels for the domestic and leased catch might affect how the shipments from the leased vessels are identified by the importing countries. The above data, however, suggests that at least in some years the part of the leased catch is being exported as Brazilian as Brazilian product, otherwise impossible results occur such as exporting more than the catch as indicated above for 1991-93 and 1996.
A - Apparent
NS - Not statistically significant
P1 - Preliminary; P2 - Instituto de Pesca preliminary estimate; P3 - NMFS projection based on U.S. import data available through October 1998 (appendix G1a)
* Includes only the domestic catch and not the catch of the leased vessels (appendix E3b1a).
** Live weight equivalent of product weight data (appendix G1a). Product weight was converted to liveweight with a conversion factor of 0.7 to 1.0.
*** The difference is presumably domestic consumption, but the sharp annual fluctuations suggest either statistical problems with the data or other unknown factors are involved with the marketing of Brazilian swordfish.
Sources: ICCAT, *Statistical Bulletin*, 1996 (catch data) and trade data of major importing countries in appendix G1a (export data).

Appendix G1b3--Brazil. Estimated domestic consumption of swordfish with provision for foreign leased landings, 1991-97

Year	Catch*		Total	Exports**	Difference***	Domestic proportion
	Domestic	Sec-Leased#				
			Metric tons			Percent
1991	721	139	860	1,210	-350A	NS
1992	629	81	710	1,361	-651A	NS
1993	674	225	899	1,816	-917A	NS
1994	969	162	1,131	521	610	54
1995	1,172	261	1,443	334	1,109	77
1996	777P	512	1,289	824	465	36
1997	752P	673P	1,425	1,783	-358	NS

P - Preliminary
Note: The authors speculated that differing marketing channels for the domestic and leased catch might affect how the shipments from the leased vessels are identified by the importing countries. The above run, however, suggests that at least in some years the shipments from the leased vessels are entered as Brazilian product, otherwise impossible results occur such as exporting more than the catch as indicated above for 1991-93 and 1997. Even when the catch of selected countries (all leased countries except Spain and Taiwan) is calculate, the results are still impossible. Reports from Brazil indicate that the Spanish and Taiwan catch is not being exported. There obviously is a serious statistical problem which the authors have been unable to identify. Possible explanations include under reporting of the domestic catch, statistical treatment of the leased catch in Brazil and importing countries, statistical problems associated with foreign import data.
A - Apparent
NS - Not statistically significant
P - Preliminary
* Includes only the domestic catch and not the catch of the leased vessels (appendix E3b1a).
** Live weight equivalent of product weight data (appendix G1a). Product weight was converted to liveweight with a conversion factor of 0.7 to 1.0.
*** The difference is presumably domestic consumption, but the sharp annual fluctuations suggest either statistical problems with the data or other unknown factors are involved with the marketing of Brazilian swordfish.
# Selected leased vessels. The authors believed the Spanish and Taiwan leased catch is shipped in such a way that does not enter available export data (appendix G1a). The leased catch listed here probably is mostly covered by available trade data.
Sources: ICCAT, *Statistical Bulletin*, 1996 (catch data) and trade data of major importing countries in appendix G1a (export data).

Appendix G1c.--Brazil. Canned exports, 1992-93

Species	Year	
	1992	1993
	Metric tons	
Sardines	17,612	17,703
Tuna	5,964	4,894
Mackerel	3,781	2,750
Other	282	1,138
Semi-conserves	265	255
Total	27,904	26,740

Source: Ministerio do Mar, Direção General das Pescas in INFOPESCA, *Noticias Comerciales*, December 20, 1994.

Appendix G2a1.--United States. Swordfish imports from Brazil, 1975-97

Year	Commodity		Total
	Fresh	Frozen	
	Metric tons		
1975	-	-	-
1976	NA	NA	2.3
1977	-	-	-
1978	-	-	-
1979	-	-	-
1980	-	-	-
1981	-	9.6	9.6
1982	-	96.2	96.2
1983	5.2	31.8	37.0
1984	19.7	17.3	37.0
1985	53.2	1.6	54.8
1986	100.3	30.0	130.3
1987	235.4	2.3	237.7
1988	464.4	-	464.4
1989	423.0	-	423.0
1990	583.1	-	583.1
1991	586.5	20.1	606.6
1992	409.1	91.4	500.5
1993	256.9	28.6	285.5
1994	265.8	70.9	336.7
1995	227.3	0.5	227.8
1996	550.2	13.2	563.4
1997	1,244.7	-	1,244.7
1998	1,390.0P	11.4*	1,400.0P

NA - Separate fresh/frozen data not available.
P - NMFS projection based on data available through November. See appendix G2g.
* Actual data through November
Source: U.S. Bureau of the Census

Appendix G2a2.--United States. Swordfish imports from Brazil, 1975-97

Year	Commodity		Total
	Fresh	Frozen	
	U.S.$1,000		
1975	-	-	-
1976	NA	NA	5
1977	-	-	-
1978	-	-	-
1979	-	-	-
1980	-	-	-
1981	-	38	38
1982	-	288	288
1983	16	80	96
1984	82	55	137
1985	204	9	213
1986	539	77	616
1987	1,613	5	1,618
1988	1,274	-	1,274
1989	945	-	945
1990	1,361	-	1,361
1991	1,519	112	1,631
1992	1,095	258	1,353
1993	702	128	830
1994	805	134	937
1995	752	3	755
1996	1,566	53	1,619
1997	3,847	-	3,847
1998P	3,874P	26*	3,900P

P - NMFS projection based on data available through November.
* Actual data through November
Note: Even though there was a substantial increase in the quantity shipped in 1998, the value of those shipments was little changed from 1997 because of the 1998 price declines (appendix G2e3).
Source: U.S. Bureau of the Census

Appendix G2b1.--United States. Swordfish imports from Brazil by Customs District, 1994-95

Customs district	1994 Value	1994 Quantity	1994 Price*	1995 Value	1995 Quantity	1995 Price*
	US$1,000	M. tons	US$/kg	US$1,000	M. tons	US$/kg
Fresh						
Miami	252.5	85.2	2.96	153.1	37.2	4.12
New York	552.6	180.5	3.06	599.2	190.1	3.15
Subtotal**	805.1	265.8	3.02	752.3	227.3	3.31
Frozen						
Miami	133.9	70.9	1.89	-	-	-
New York	-	-	-	2.5	0.5	5.00
Subtotal**	139.9	70.9	1.89	2.5	0.5	5.00

* Apparent prices derived from dividing the total import value by the quantity.
** Totals may not agree due to rounding.
Source: U.S. Bureau of the Census.

Appendix G2b2.--United States. Swordfish imports from Brazil by Customs District, 1996-97

Customs district	1996 Value	1996 Quantity	1996 Price*	1997 Value	1997 Quantity	1997 Price*
	US$1,000	M. tons	US$/kg	US$1,000	M. tons	US$/kg
Fresh						
Boston	275.2	69.1	3.98	795.2	270.6	2.94
Los Angeles	1.5	0.5	3.00	-	-	-
Miami	580.5	203.4	2.85	2,130.4	656.2	3.24
New York	708.4	277.3	2.55	921.0	318.0	2.90
Subtotal**	1,565.6	550.3	2.84	3,846.6	1,244.8	3.09
Frozen						
Boston	52.9	13.2	4.01	-	-	-
Miami	-	-	-	-	-	-
New York	-	-	-	-	-	-
Subtotal**	52.9	13.2	4.01	-	-	-

* Apparent prices derived from dividing the total import value by the quantity.
** Totals may not agree due to rounding.
Source: U.S. Bureau of the Census.

Appendix G2c.--United States. Apparent prices** of swordfish imports from Brazil, 1980-98

Year	Prices		Difference
	Fresh	Frozen	
	US$/kg	Metric tons**	US$
1982	-	2.99	NA
1983	3.08	2.52	0.56
1984	4.16	3.18	0.98
1985	3.83	5.63#	-1.08
1986	5.37	2.57	2.80
1987	6.85#	2.17	4.68
1988	2.74	-	NA
1989	2.23	-	NA
1990	2.33	-	NA
1991	2.59	5.57	2.98
1992	2.68	2.82	-0.14
1993	2.73	4.47	-1.74
1994	3.03	1.89	1.14
1995	3.31	5.00	-1.69
1996	2.84	4.01	-1.17
1997	3.09	-	NA
1998***	2.85	2.30	-0.55

NA - Not applicable (no frozen shipments).
* Small quantities involved (less than 10 tons).
** Apparent prices calculated by dividing the value of imports by the quantity (appendices G2a1-2 and G2e1-2).
*** Through November
# Record
Source: U.S. Bureau of the Census

Appendix G2d1.--United States. Imports of fresh swordfish, 1994-95

Country	1994		Country	1995	
	Value	Proportion		Value	Proportion
	US$1,000	Percent		US $1,000	Percent
Canada	11,544	45	Canada	12,074	42
Chile	8,114	32	Chile	8,352	30
Trinidad	1,397	5	Trinidad	2,319	8
Mexico	1,353	5	Mexico	1,545	5
Brazil	805	3	Uruguay	1,051	4
Venezuela	497	2	Fiji	778	3
			Brazil	752	3
Other	1,855	7	Other	1,986	7
Total*	25,565	100		28,860	100

* Totals may not agree due to rounding.
Source: U.S. Bureau of the Census

Appendix G2d2.--United States. Imports of fresh swordfish, 1996-97

Country	1996		Country	1997	
	Value	Proportion		Value	Proportion
	US$1,000	Percent		US $1,000	Percent
Chile	7,315	24	Chile	13,229	26
Canada	5,625	18	Costa Rica	9,889	20
Costa Rica	5,112	17	Canada	6,805	13
Uruguay	2,721	9	Brazil	3,847	8
Trinidad	1,894	6	Uruguay	3,672	7
Brazil	1,566	5	Australia	2,291	5
Other	6,280	21	Mexico	2,202	4
			Trinidad	1,902	4
			Ecuador	1,675	3
			Venezuela	1,063	2
			New Zealand	1,025	2
			Taiwan	970	2
			Other	1,945	4
Total*	30,513	100		50,515	100

* Totals may not agree due to rounding.
Source: U.S. Bureau of the Census

Appendix G2e1.--United States. Apparent prices of fresh swordfish imports, 1994-96

Country	1994 Quantity Metric tons	1994 Value US$1,000	1994 Price US$/kg	Country	1995 Quantity Metric tons	1995 Value US$1,000	1995 Price US$/kg	Country	1996 Quantity Metric tons	1996 Value US$1,000	1996 Price US$/kg
Major suppliers											
Canada	1,231.9	11,544	9.37	Canada	1,258.4	12,074	9.59	Canada	532.6	5,625	10.56
Chile	1,095.5	8,114	7.41	Chile	1,087.9	8,352	7.68	Chile	855.6	7,315	8.55
Trinidad	240.0	1,397	5.82	Trinidad	417.4	2,319	5.55	Costa Rica	709.1	5,112	7.21
Mexico	261.4	1,353	5.18	Mexico	335.8	1,545	4.61	Trinidad	324.6	1,894	5.83
Uruguay	95.8	387	4.04	Uruguay	297.9	1,052	3.54	Uruguay	479.5	2,721	5.67
Brazil	265.8	805	3.03	Brazil	227.3	752	3.31	Mexico	343.9	1,435	4.17
								Brazil	550.2	1,566	2.84
Lesser Latin American suppliers											
Bermuda#	12.4	132	10.68	Antigua	18.2	160	8.78	Grenada	Negl	2	16.48
St. Vincent	0.4	3	8.74	St. Vincent	0.5	4	7.23	Peru	Negl	5	11.09
Antigua	35.8	302	8.43	Costa Rica	27.3	177	6.47	Barbados	41.4	245	5.91
Peru	0.4	3	6.94	Barbados	63.3	318	5.02	Ecuador	213.1	1,069	5.01
Costa Rica	11.6	75	6.48	Ecuador	80.2	348	4.33	Nicaragua	1.3	9	7.25
Barbados	8.9	44	5.08	Venezuela	89.8	314	3.50	Venezuela	190.4	968	5.09
Venezuela	99.9	497	4.98	Paraguay	3.3	11	3.38	St. Vincent	5.5	26	4.80
Grenada	2.8	14	4.94					Neth. Ant.	12.1	38	3.10
Ecuador	79.6	269	3.38								
Nicaragua	6.1	17	2.74								
Other countries	116.5	1,356	5.26	All other	296.6	1,434	4.83		476.2	28,030	5.21
Totals*											
Without Canada##	2,320.5	13,889	5.99		2,945.5	16,786	5.70		4,202.9	24,884	5.92
All countries	3,564.8	25,565	7.17		4,203.9	28,860	6.86		4,735.5	30,513	6.44

* Totals may not agree due to rounding.
\# Caught mostly by Canadian fishermen.
The totals excluding the premium Canadian and Bermudan (caught mostly by Canadian fishermen) product may be a better bench mark for comparing Latin American shipments.
Source: U.S. Bureau of the Census

Appendix G2e2.--United States. Apparent prices of fresh swordfish imports,* 1997

Commodity/ country	1997 Quantity	Value	Price
	Metric tons	US$1,000	US$/kg
Trunks			
Major suppliers			
Canada	764.3	6,603	8.64
Chile	1,581.4	11,214	7.09
Trinidad	267.0	1,889	7.07
New Zealand	149.3	1,020	6.83
Venezuela	159.3	1,063	6.67
Costa Rica	1,534.7	9,772	6.37
Uruguay	648.3	3,668	5.66
Ecuador	300.5	1,646	5.48
Australia	457.0	2,291	5.01
Mexico	525.0	2,202	4.19
Brazil	1,244.8	3,847	3.09
Total	7,611.5	45,215	5.94
Lesser Latin American countries			
Peru	9.7	100	10.31
Grenada	0.7	6	8.57
St. Vincent	0.3	2	6.66
Nicaragua	3.7	23	6.22
Barbados	71.2	425	5.97
El Salvador	0.8	2	2.50
Guatemala	1.4	2	1.43
	87.8	560	6.38
All other countries	495.9	2,360	4.76
Steaks			
Trinidad	0.7	13	18.57
New Zealand	0.5	5	10.00
Chile	216.7	2,015	9.30
Ecuador	3.4	29	8.53
Portugal	0.3	2	6.67
Canada	35.4	202	5.71
Costa Rica	23.3	112	4.81
Uruguay	1.9	4	2.11
Totals	282.1	2,381	8.44
Total*			
Excluding Canada#	7,677.6	43,711	5.69
All countries	8,477.3	50,516	5.96

* Totals may not agree due to rounding.
# The totals excluding the premium Canadian and Bermudan (caught mostly by Canadian fishermen) product may be a better bench mark for comparing Latin American shipments. Canadian product once dominated the U.S. market, but has become less important in recent years.
Source: U.S. Bureau of the Census

Appendix G2e3.--United States. Apparent prices of fresh swordfish imports,* by month 1997-98

Month	Apparent prices 1997	1998
	US$/kg	
January	3.39	2.76
February	3.34	2.88
March	3.04	2.80
April	2.63	3.06
May	3.26	3.09
June	2.78	2.76
July	3.50	2.89
August	3.25	2.72
September	2.87	2.68
October	3.09	2.69
November	2.97	3.00
December	3.17	NA
Total*	3.09	2.85**

* Totals may not agree due to rounding. This is a weighted monthly average.
** Through November
Source: U.S. Bureau of the Census

Appendix G2f1.--United States. Apparent prices of frozen swordfish imports, 1994-96

Country	1994			Country	1995			Country	1996		
	Value	Quantity	Price		Value	Quantity	Price		Value	Quantity	Price
	US$1,000	Metric tons	US$/kg		US$1,000	Metric tons	US$/kg		US$1,000	Metric tons	US$/kg
Japan	1,807	182.7	9.89	Japan	1,363	140.0	9.74	Japan	867	75.9	11.43
Canada	27	2.9	9.03	Chile	13	1.5	8.67	Indonesia	37	4.7	7.83
Thailand	70	9.9	7.00	Singapore	330	52.4	6.30	Spain	91	13.3	6.86
Chile	579	84.7	6.84	Indonesia	38	6.7	5.63	Singapore	1,161	223.7	5.19
Singapore**	487	92.2	5.28	South Africa	887	159.0	5.58	Taiwan	185	44.9	4.11
Taiwan	1,064	239.0	4.45	Thailand	65	11.7	5.55	Brazil	13	52.9	4.00
Uruguay	376	96.5	3.90	Brazil	3	0.5	5.51	Ecuador	1	0.7	2.71
South Africa	75	19.4	3.86	Taiwan	245	57.2	4.28	Mexico	39	27.6	1.43
Micronesia	3	0.7	3.62	Portugal	3	0.8	4.00				
Mexico	42	12.0	3.55	China	99	45.9	2.16				
China	11	3.2	3.31	Korea (ROK)	5	1.7	2.81				
Brazil	134	70.9	1.89								
Ecuador	1	0.1	NS								
Total*	4,676	814.3	5.74		3,049	477.2	6.39		404	2,435.7	6.03

NS - Not statistically significant
* Totals may not agree due to rounding.
** Shipments from Singapore are almost certainly transhipments from other countries, probably Taiwan and Japan.
Source: U.S. Bureau of the Census

Appendix G2f2.--United States. Apparent prices of frozen swordfish imports, 1997

Commodity/ country	1997 Value	Quantity	Price
	US$1,000	M. tons	US$/kg
Fillets			
Japan	2,140	220.7	9.70
Singapore	37,785	5,806.1	6.51
Indonesia	512	105.5	4.85
Taiwan	1,948	408.6	4.77
Chile	462	304.6	1.52
Other	119	27.4	4.34
Total	42,966	6,872.9	6.25
Trunks			
Singapore	370	60.9	6.08
Indonesia	48	9.1	5.27
Japan	73	14.0	5.21
Other	95	34.0	2.79
Total	586	118.0	4.97
Steaks			
Japan	1,009	83.2	12.13
Singapore	334	45.2	7.39
Other	13	1.5	8.67
Total	1,356	129.9	10.44
Total*	44,908	7,120.8	6.31

NS - Not statistically significant
* Totals may not agree due to rounding.
** Shipments from Singapore are almost certainly transhipments from other countries, probably Taiwan and Japan.
*** Flag-of-convenience
Source: U.S. Bureau of the Census

Appendix G2g.--United States. Swordfish imports from Brazil by month, 1990-98

Month	Year 1990	1991	1992	1993	1994	1995	1996	1997	1998
	Metric tons#								
January	14.8	16.3	48.1	30.6	15.5	7.8	11.3	33.8	58.9
February	16.2	31.6	73.2	9.5	29.9	6.1	59.3	49.1	150.5
March	30.1	19.7	14.3	19.9	18.4	26.1	82.9	94.4	160.7*
April	20.1	16.0	17.1	13.4	13.1	15.7	27.1	52.1	124.9
May	23.5	23.8	12.3	11.6	22.4	20.5	37.1	99.8	123.0
June	39.9	39.0	32.4	18.1	36.6	16.6	61.2	62.3	117.6
July	63.7	70.2	73.9	23.7	39.3	10.3	74.7	140.2	148.0
August	153.4*	85.8	68.2	37.1	57.9*	25.8	82.8*	181.9*	89.9
September	117.4	78.6	85.2*	58.2*	18.7	16.9	51.9	162.1	111.6
October	45.1	96.9*	35.9	28.1	40.4	19.1	27.9	129.6	105.4
November	32.2	69.1	28.1	17.5	23.1	41.9*	8.8	159.1	80.8
December	26.5	59.5	11.7	17.8	21.2	20.9	38.4	80.5	NA
Total##	583.1	606.6	500.4	285.4	336.6	227.8	563.5	1,244.8	1,271.3**

NA - Not available
* Peak month of the year
** Through November. The total for all of 1998 will probably total nearly 1,400 t, an all time record.
# Product weight
Totals may not agree due to rounding
Source: Bureau of the Census

Appendix G3a.--Japan. Swordfish and marlin imports from Brazil, 1986-97

Year	Quantity	
	Billfish	Swordfish
	Metric tons	
1986	3	1E
1987	9	3E
1988	2	1E
1989	-	-
1990	-	-
1991	4	1E
1992	192	64E
1993	222	74E
1994	-	-
1995	-	
1996	NA	NA
1997*	3	1E

E - Estimated swordfish proportion of billfish imports. Unfortunately the authors do not have any data on the species composition of Japanese imports. This estimate is based on the approximate catch composition, taken into account that much of Brazil's swordfish is marketed in the United States. The Brazilian trade pattern is further complicated by a prosperous Japanese ethnic population, especially in the São Paulo area, willing and able to pay international prices for high quality tunas and billfish. (The light-fleshed swordfish is of less interest.) With inadequate data to accurately estimate actual swordfish shipments, the above estimate is intended primarily as a rough place marker of about one-third of the total shipments to Japan, in lieu of accurate data.
NA - Not available
* The Japanese modified their import categories in 1997, providing some more detailed data (appendix G3b).
Source: Japan Tariff Association, *Japan Exports & Imports*, various years.

Appendix G3b.--Japan. Swordfish and billfish imports from Brazil, 1997

Year	Fresh*	Frozen			Total
		Fillets*	Other		
			Swordfish	Billfish	
		Metric tons			
1997	2.6	-	-	-	2.6
1998	-**	-**	-**	-**	-**

Note: The Japanese modified their import categories in 1997. The new more detailed format, however is only available beginning in 1997.
* Japanese Customs use categories combining swordfish with billfish.
** Through March
Source: Japan Tariff Association, *Japan Exports & Imports*, various years.

Appendix G4.--European Union. Swordfish imports from Brazil, 1991-98

Country	Commodity	Year							
		1991	1992	1993	1994	1995	1996	1997	1998
		Metric tons							
Denmark	Frozen trunks	-	1	4	-	-	-	-	-#
France	Frozen trunks	-	3	44	-	-	-	-	-#
Germany	Frozen trunks	-	-	40	-	-	-	-	-#
Italy	Frozen trunks	49	278	110	-	-	-	-	-#
Netherlands	Frozen trunks	-	-	36	-	-	-	-	-#
Portugal	Fresh	1	-	-	-	-	-	-	1#
	Frozen trunks	-	-	14	-	-	-	-	-#
Spain	Fresh	4	10	3	7	6	14	-	15#
	Frozen trunks	185	92	660	21	-	-	120	42#
	Frozen fillets	-	4	-	-	-	-	-	-#
Total		239	388	911	28	6	14	120	58#

Through July
Source: EU. Eurostat data.

Appendix G5.--Brazil. Shark imports from Uruguay, 1997

Product/ species	Imports		Average
	Quantity	Value	
	Metric tons	US$1,000	US$/kg
Fresh			
Whole			
Argentine angel	4.6	2.3	0.49
Soupfin	80.0	93.6	1.17
Eviscerated			
Argentine angel	131.8	78.2	0.59
Soupfin	121.7	69.9	0.57
H&G			
Sharks	22.0	23.3	1.06
Frozen			
Whole			
Argentine angel	0.8	0.6	0.70
Soupfin	3.5	3.8	1.07
Ray*	54.1	57.3	1.06
Other	10.3	9.8	1.00
Eviscerated			
Argentine angel	6.8	4.7	0.70
Soupfin	23.7	32.9	1.39
Other	8.0	10.1	1.26
H&G			
Blue	21.4	26.9	1.26
Other	500.1	716.6	1.43
Filet			
Shark	19.3	33.7	1.75
Skinned			
Soupfin	24.1	46.1	1.91
Soothhound	1.4	2.6	1.85
Total	1,033.6	1,212.4	1.17

Note: Makos are mostly exported to the United States and fins to China.
* Most of Uruguay's ray exports were shipped to Korea.
Source: INAPE, *Informe Sectorial Pesquero*, 1997, pp. 24-37.

Appendix H.--Government agencies, research institutes, companies, and other groups involved in the pelagic longline fishery

Government Agencies

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Kowalski: See Com. E Ind De Pescados Kowalski

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* Non-fishery institutes, like the Instituto Forestal, are included because of their work on bycatch issues in areas like seabirds.

Appendix I1.--Brazil. Longline species glossary

Portuguese	English	Scientific
Longline species		
Agulhao	Marlin	
Agulhao-negro/kurokava#	Blue	Makaira nigricans
Agulhao-branco/maka#	White	Tetrapturus albidus
Agulhão-vela/bacho#	Sailfish	Istiophorus albicans
Atum/albacora*	Tuna	Thunnus spp.
Azul	Bluefin	T. thynnus
Albacora-bandolin	Bigeye	T. obesus
Albacora-branca	Albacore	T. alalunga
Albacora-laje/vermelho	Yellowfin	T. albacares
Bonito-listado	Skipjack	Katsuwonus pelamis
Caçao/machote	Sharks	
Anjo	Angel	Squatina argentina, S. guggenhein, and S. oculta
Azul/mole-mole	Blue	Prionace glauca
Jaguaras	Tiger	Galeocerdo cuvier
Martelo	Hammerhead	Sphyrna zygaena and S. lewini
Mouka	Porbeagle	Lamna nasus
Mouro	Mako	Isurus oxyrinchus
Sucuri da galha preta	Various	Carcharhinus sp.
Mouka	Porbeagle	Lamna nasus
??	Soupfin	Galeorhinus galeus
??	Smooth dogfish	Mustelus canis and M. schmitti
Cavala-empinge	Wahoo	Acanthocybium solandri
Dourado-do-mar	Dorado	Coriphaena hippurus
Espadarte*/meca#	Swordfish	Xiphias gladius
Peixe-papagaio	Opahs/sunfish	Lampris guttatus
Peixe prego/rato	Escolar/ snake mackerel	Lepidocybium flavobrunneum
Peixe prego/rato	Oilfish	Ruvettus pretiosus
Bait species		
Calamar**	Squid	Illex argentinus
Cavalinha**	Mackerel (horse)	Scomber japonicus
Sardinhas**	Sardines	

* Principal target species of the longline fishery
** Trials off southern Brazil suggest that squid (*I. argentinus*) is the primary fodder species for swordfish. (See: appendix C3a.)
# Shortened versions of the Japanese names for several of the species taken in the longline fishery are often more commonly used than the Portuguese names: bacho/bachokagiki (sailfish), maka/makakagiki (marlin), and meca/mecakagiki (swordfish).
Source: Various

Appendix I2.--Brazil. Longline fisheries glossary

Portuguese	English
Arrendada	Leased
Espinhel	Longline
Isca	Bait
Frota	Fleet

Source: Various